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ISSUE 48 MAY 2016

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Experts in this issue



STEFAN HANSEN Test engineer

Hansen works at the largest aeroplane repair factory in the world. He and his team are tasked with examining and repairing more than 10,000 parts in just 32 days.

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»An aeroplane maintained by us can theoretically fly forever.«



HANS-JÜRGEN KRYSMANSKI Political scientist

The Bilderberg conference is an annual event where, according to the sociology professor, influential players from the worlds of finance and the economy get together to plan the politics of tomorrow.

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KELLIE TRANTER Water law expert

The lawyer explains how, in the future, only those with enough money will be able to afford the luxury good that water will become. It's already more expensive than petrol in one part of the world.

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JOHN INGLIS Former NSA vice-president

The former intelligence agent has uncovered a squad of cyber-terrorists that pose a threat to America's electricity grid. The eerie thing? They work without computers or explosives...

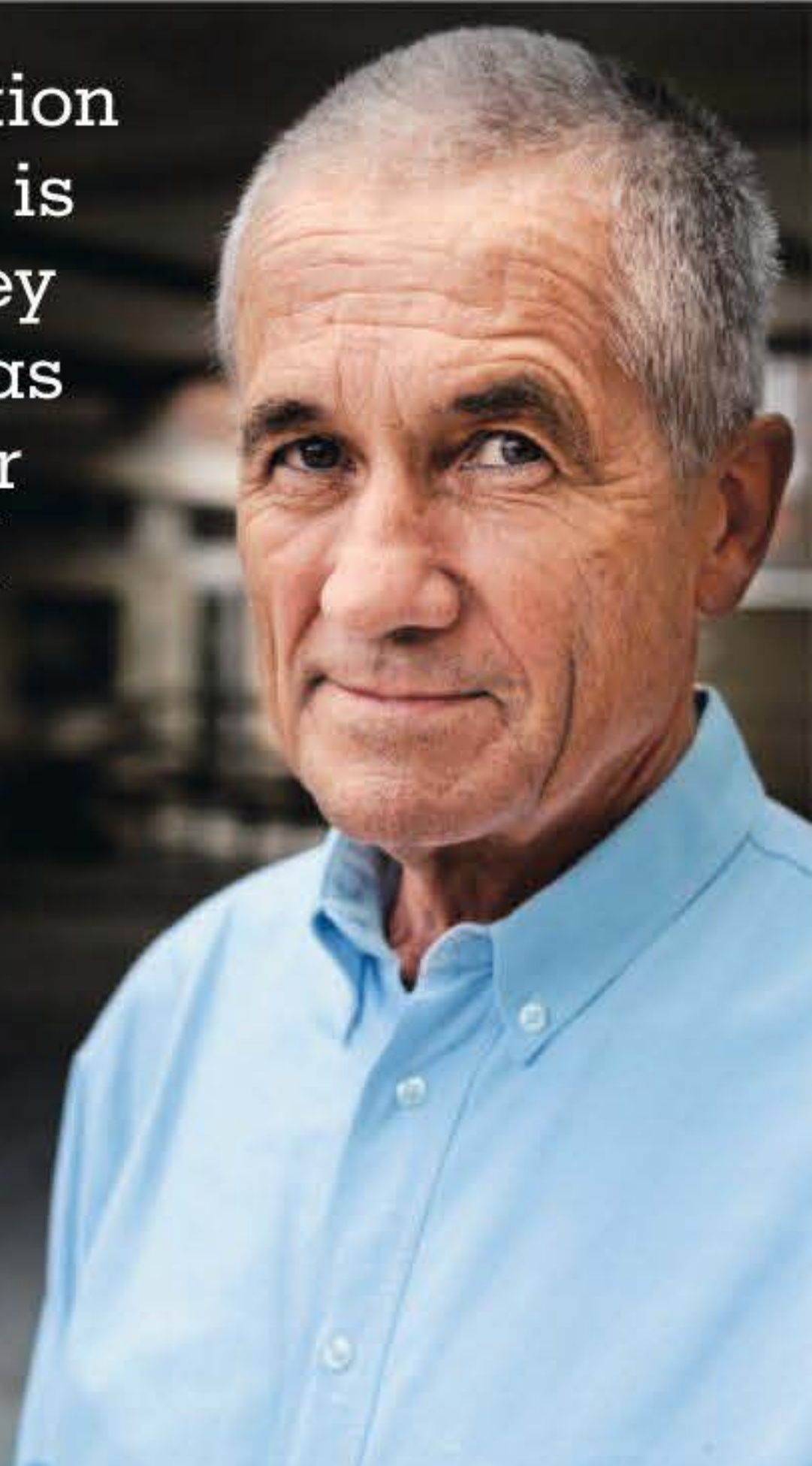
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» The manipulation of clinical studies is so serious that they are only suitable as advertisements for medical drugs. «

PETER GÖTZSCHE Medical researcher

The director of the Nordic Cochrane Center at the Rigs Hospital in Copenhagen says that in up to 61% of funded studies, drug companies deliberately manipulate some of the data.

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EMMA TEELING Geneticist

The biologist at the University of Dublin is researching the genes of bats. Teeling is convinced that they hold the key to fighting the most deadly epidemics in the world.

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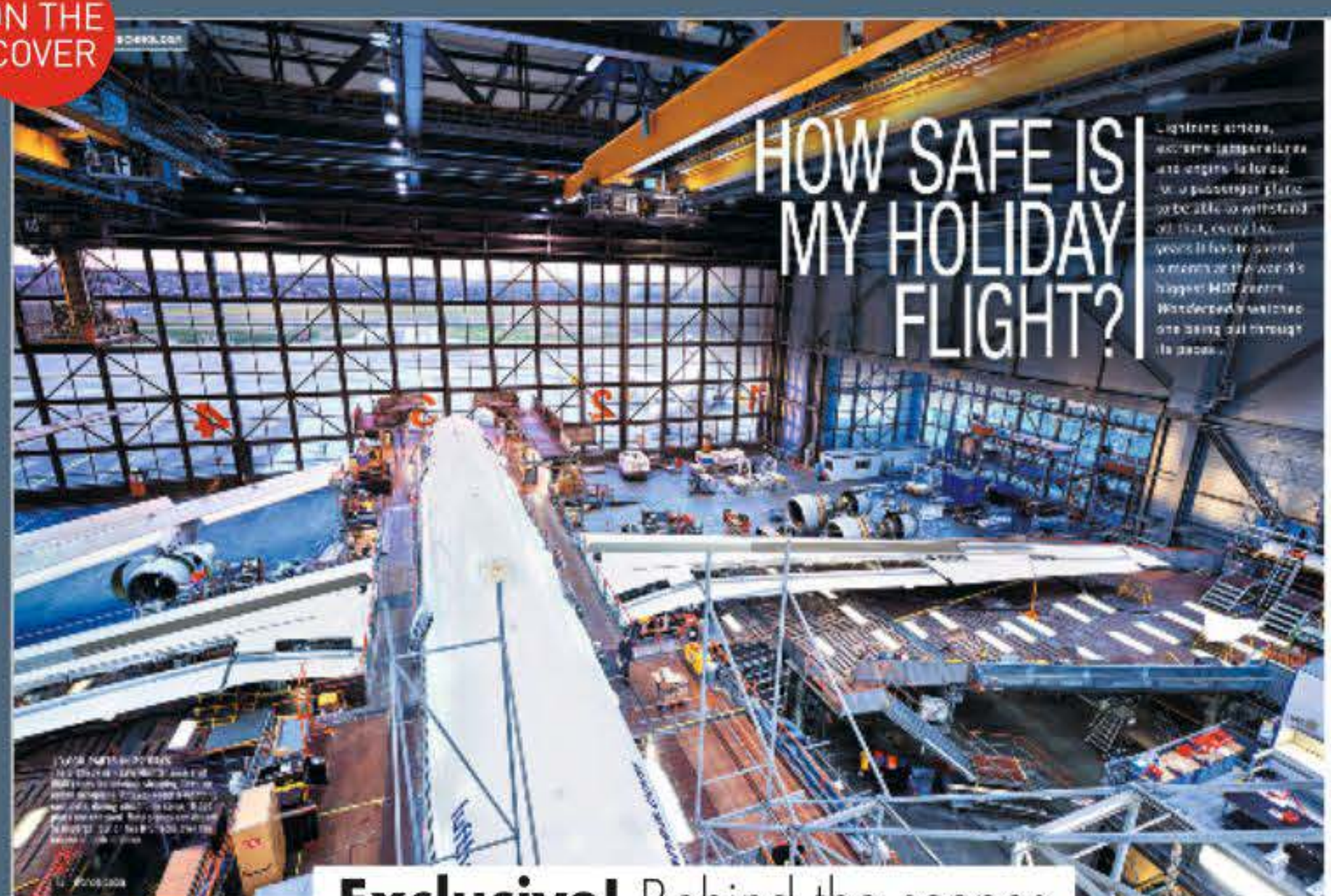
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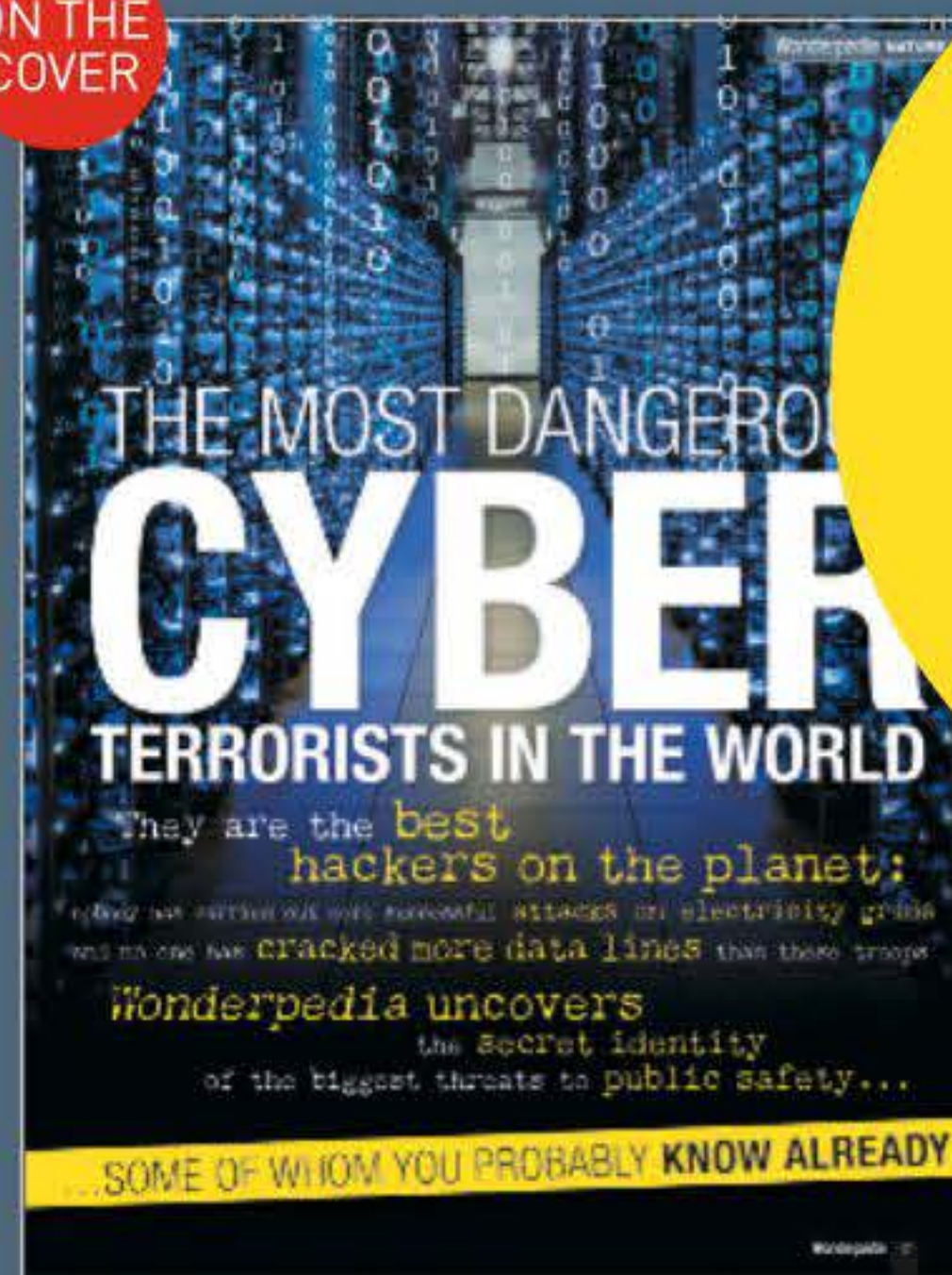
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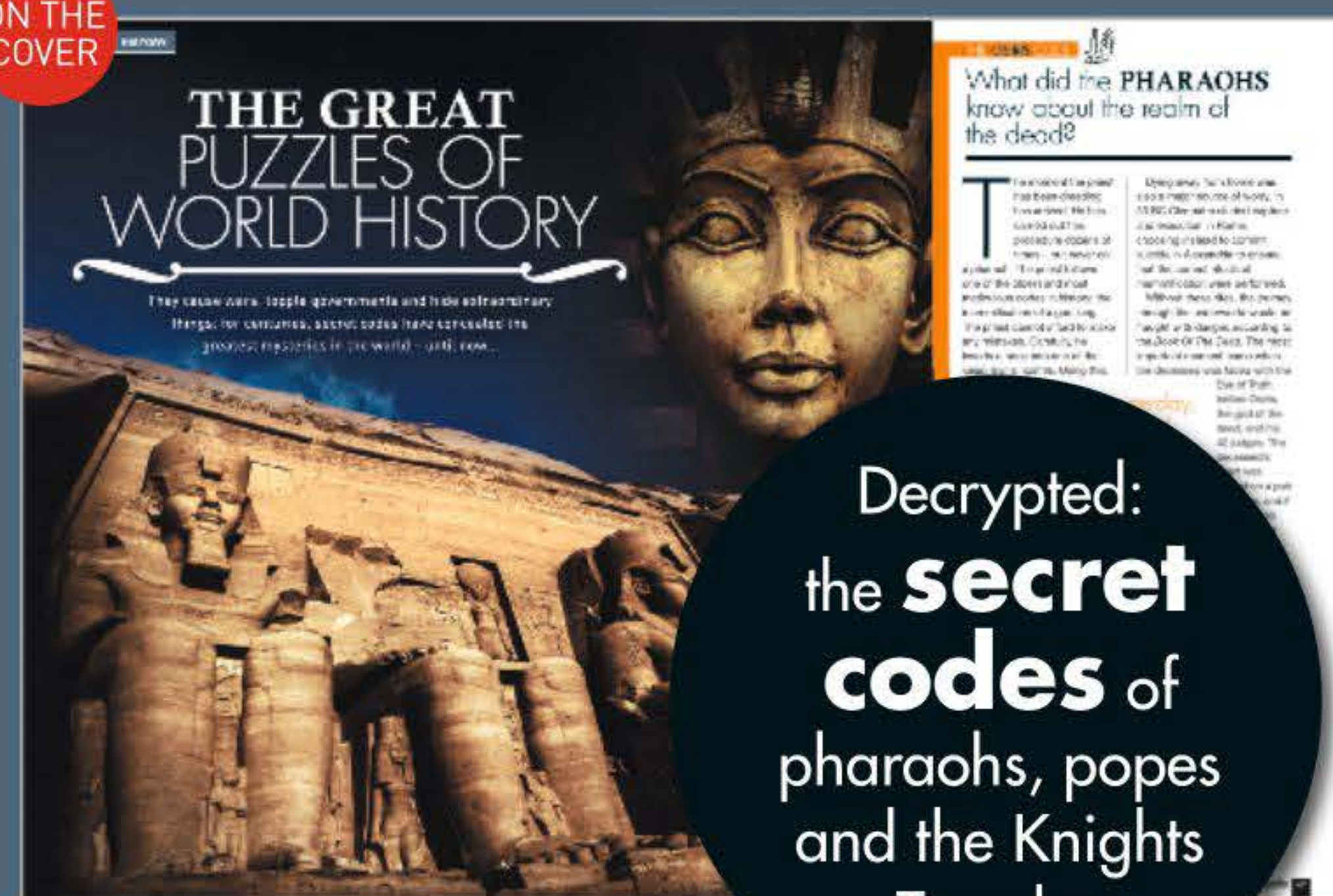
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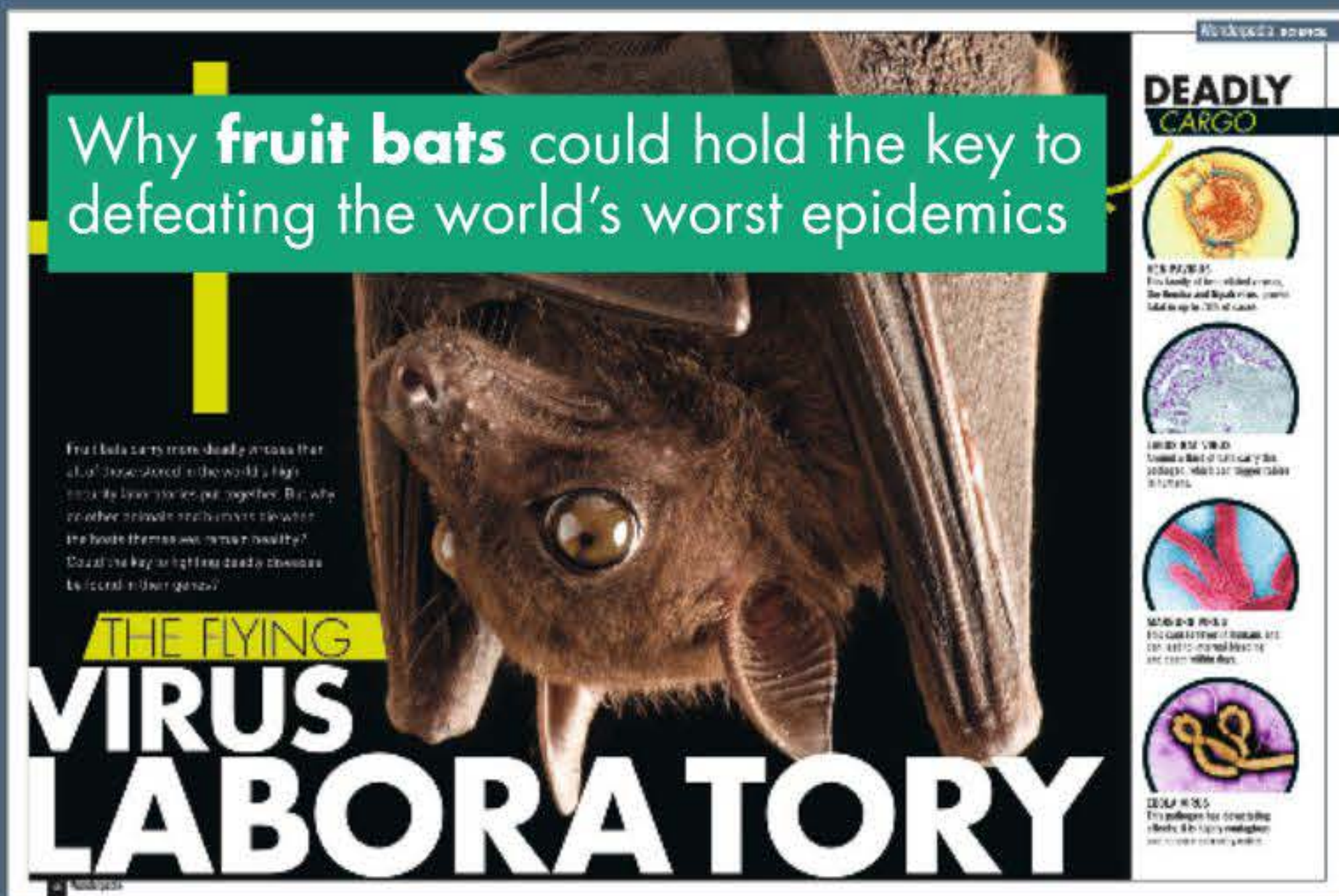
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How rebounding bullets can turn into unpredictable killers...

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[THE STORY BEHIND THE PHOTO]



POOCH ON PATROL

Birds represent one of the biggest safety risks at airports. With one exception: the Cherry Capital Airport in Michigan. That's because Piper works there. In goggles, ear muffs and doggy boots, the border collie keeps the runways bird-free – even in the most extreme conditions...

The eight geese waddling in the grass next to the runway have no idea. But Piper does. He knows it's only a matter of minutes before the three o'clock flight taxis onto the runway at Cherry Capital Airport – and the birds are posing a serious flying hazard...

Piper is an eight-year-old border collie – and a US Coast Guard airport security officer. His job: to keep the runway free from pesky birds during takeoffs and landings. There aren't many things pilots fear more than a bird flying into one of their engines. Over the years, dozens of aircraft have been brought down this way. Seconds later, Piper sprints from his base to bark at the birds, forcing them to retreat to a safe distance. Mission accomplished. The control tower gives the pilot the all-clear: the runway is ready for takeoff.

Piper works four days a week in four-hour shifts, patrolling the airport. He collects sticks and detritus from the taxiways and drives away ducks, pigeons and geese. Over the past year alone, he's driven away 2,450 birds.

The other half of the airport's K-9 team is his handler, Brian Edwards, pictured

below with Piper. "Border collies' herding instinct means they are perfect for this job," says Edwards. Like any other runway worker, Piper is provided with earmuffs to protect against engine noise and goggles to see in snowdrifts. He also wears boots to shield his paws from extremes of temperature: it can fall to minus 20°C in winter, while in summer the tarmac can get blisteringly hot.


The hardy pooch has only ever once called in sick, after suffering a leg fracture chasing an owl. Thankfully he was only off for a few weeks and soon resumed his familiar position on the side of the runway – much to the delight of the pilots...



PHOTOS: TVC K9-Team

DANGEROUS TERRAIN

Armed with a machete, Andrew Wood fights his way through the jungle of La Mosquitia. The ex-SAS officer's job is to protect the research team from the dangers of the Honduran rainforest. But venomous snakes, hungry jaguars and disease-carrying insects are not the only threats lurking in the undergrowth...



SEARCHING FOR THE 'WHITE CITY'

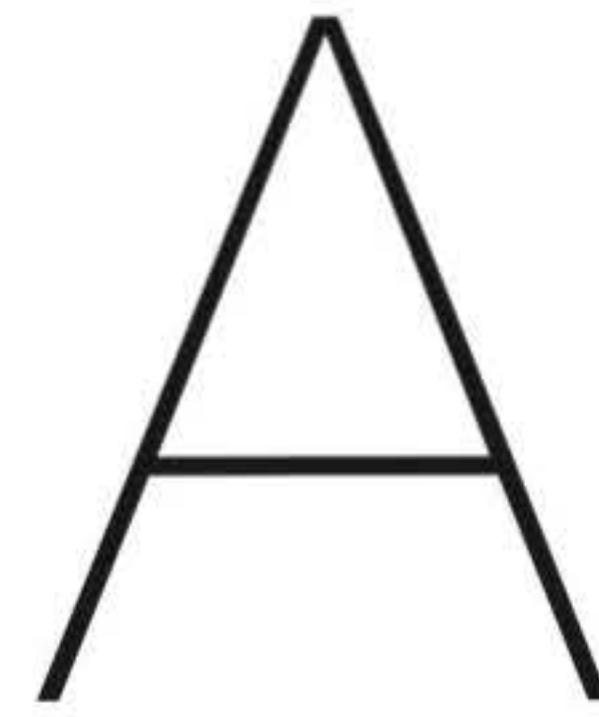
THE BATTLE FOR A LOST LEGEND

Deep in the Honduran jungle a team of researchers has stumbled upon an archaeological sensation: the ruins of an ancient civilisation that existed long before the Incas and the Aztecs. Miles from anywhere, the discovery site is located in the middle of a highly dangerous region. One that's ruled by the most feared drug cartels in Central America...



MYSTERIOUS SCULPTURES

Archaeologists stumbled upon 52 well-preserved artefacts – including pots carved with images of snakes, statues and an ornate throne made from stone. The researchers suspect that they were left behind as a sacrificial offering many centuries ago – and that many more treasures lie buried in the earth.



t long last, Steve Elkins is where he always wanted to be. The filmmaker can feel his heart pounding as he stands on the

riverbank and peers expectantly into the sprawling undergrowth of ferns and creepers. Many explorers have tried to track down the mythical *Ciudad Blanca* ('White City') in the Honduran rainforest, but none has got as close as him. Elkins pauses for a moment and listens to the sound of the river. Then he gathers his thoughts and makes his way back to the rest of the team – to tackle the final leg of their mission...

"The discovery shows that even in the 21st century there are **infinite amounts we still do not know about our world.**"

Oscar Neil Cruz, Archaeologist

Carefully, the researchers clamber up the treacherous, leaf-covered slope. Time and again they find themselves clinging onto liana vines to avoid slipping on the damp leaves, but eventually they reach the top. While support team leader Andrew Wood, an ex-SAS officer, keeps a vigilant eye on the surroundings, Elkins and the team start to examine the area. Suddenly the archaeologist discovers a small tip protruding from the ground – then another, and another. Before





DISCOVERY SITE

The jungle of La Mosquitia, a border region between Honduras and Nicaragua, is considered one of the largest, most dangerous and impenetrable rainforests in Central America. In this previously unexplored valley the researchers came across the remains of a pre-Columbian city.



they know it, the researchers have uncovered more than 50 artefacts and the remains of an earthen pyramid. For Elkins there's no longer any doubt: "It's just as I thought, all this terrain has been modified by human hands." But is this really the legendary White City that the team has stumbled across?

WHAT TECHNOLOGY CAN PENETRATE EVEN THE DENSEST JUNGLE?

Covering an area of some 20,000 square miles, the rainforest in the Mosquitia region of Honduras and Nicaragua is not only the largest in Central America, it is also home to a 500-year-old myth: ever since 1526, when the Spanish conquistador Hernán Cortés first told of mysterious, fabulously wealthy towns hidden deep in the Honduran jungle, explorers, adventurers and prospectors have been trying to find the mythical city with the white walls. The problem: most of those who entered the jungle never returned – and the few who did manage it later died in mysterious circumstances...

The story didn't deter Steve Elkins. Ever since the mid-'90s, the documentary filmmaker has been trying to discover the exact whereabouts of the White City. He's studied archaeological reports, pored over accounts from drug smugglers and geologists and examined satellite data from NASA. In the process Elkins came across what he thought would be the perfect hiding place for a kingdom: an undiscovered valley in the northeast of the rainforest. But until he finds some way of looking through the thick jungle canopy, the city will remain a myth.

In 2010, while researching the discovery of the Maya city of Caracol in Belize, Elkins reads about a technique called LiDAR

(Light Detection And Ranging) – a technology which uses lasers to scan the rainforest and, importantly, sheds light on what lies beneath the dense tree cover. Elkins' thrill of the chase quickly reaches new heights. Together with researchers from the University of Houston he charts a plane and flies over several valleys in the Honduran rainforest, shooting images with a special laser camera. Then, with archaeologist Chris Fisher, he examines the data – and finds rectangular structures that could only have been made by human hands. In two nearby valleys they find ruins stretching for miles, consisting of pyramids, plazas, terraced fields and canals. Even if this wasn't the fabled White City, the researchers had clearly taken an important step closer to it with this discovery. "Even in this remote jungle," says Fisher, "where people

"I just thought to myself: if I were a king, this would be the perfect place to hide my kingdom."

Steve Elkins, Documentary maker

wouldn't expect it, we now have evidence that there were dense populations living in cities – thousands of people."

With the help of the Honduran government, Elkins puts a team together and returns to the jungle – this time to explore the lost cities on foot. On 18th February 2015, Andrew Wood is the first to step from the helicopter. Using his machete, the former SAS officer clears a landing spot and sets up a



HOW DO YOU SCAN A JUNGLE?

Documentary filmmaker Steve Elkins has spent a good chunk of his life trying to track down the legendary 'White City'. For years he studied archaeological reports, read accounts from smugglers and prospectors and examined data from NASA satellites – all without success. It was only thanks to LiDAR technology that he got his breakthrough: helped by a research team from the University of Houston, Elkins flew over the region and directed hundreds of thousands of laser pulses through the tree canopy to the ground below. By digitally stripping away the blanket-like canopy cover, the team discovered two cities with pyramids, plazas and farm terraces.

i ARCHAEOLOGY FROM THE AIR

At a speed of 70 metres per second the plane flies at a constant altitude over the jungle and directs hundreds of thousands of infrared laser pulses towards the ground. By identifying the laser points that reach and reflect off the ground, the tree canopy can be digitally stripped away, leaving a bare-earth topographic model. The problem: LiDAR technology doesn't come cheap – scanning the three valleys in La Mosquitia cost Elkins a cool \$250,000.

610 metres
cruising height over
the tree canopy

POINT CLOUD
Most beams of light reflect off the tree cover, but some penetrate the thick foliage, reach the ground and are then reflected back through gaps in the canopy. Recording how long it takes the light to return to the device produces a 'point cloud'. From this, a 3D model of the forest canopy is created.

LASER PULSES
Using LiDAR (Light Detection and Ranging) technology, large areas can be scanned from the air.

FOREST CANOPY

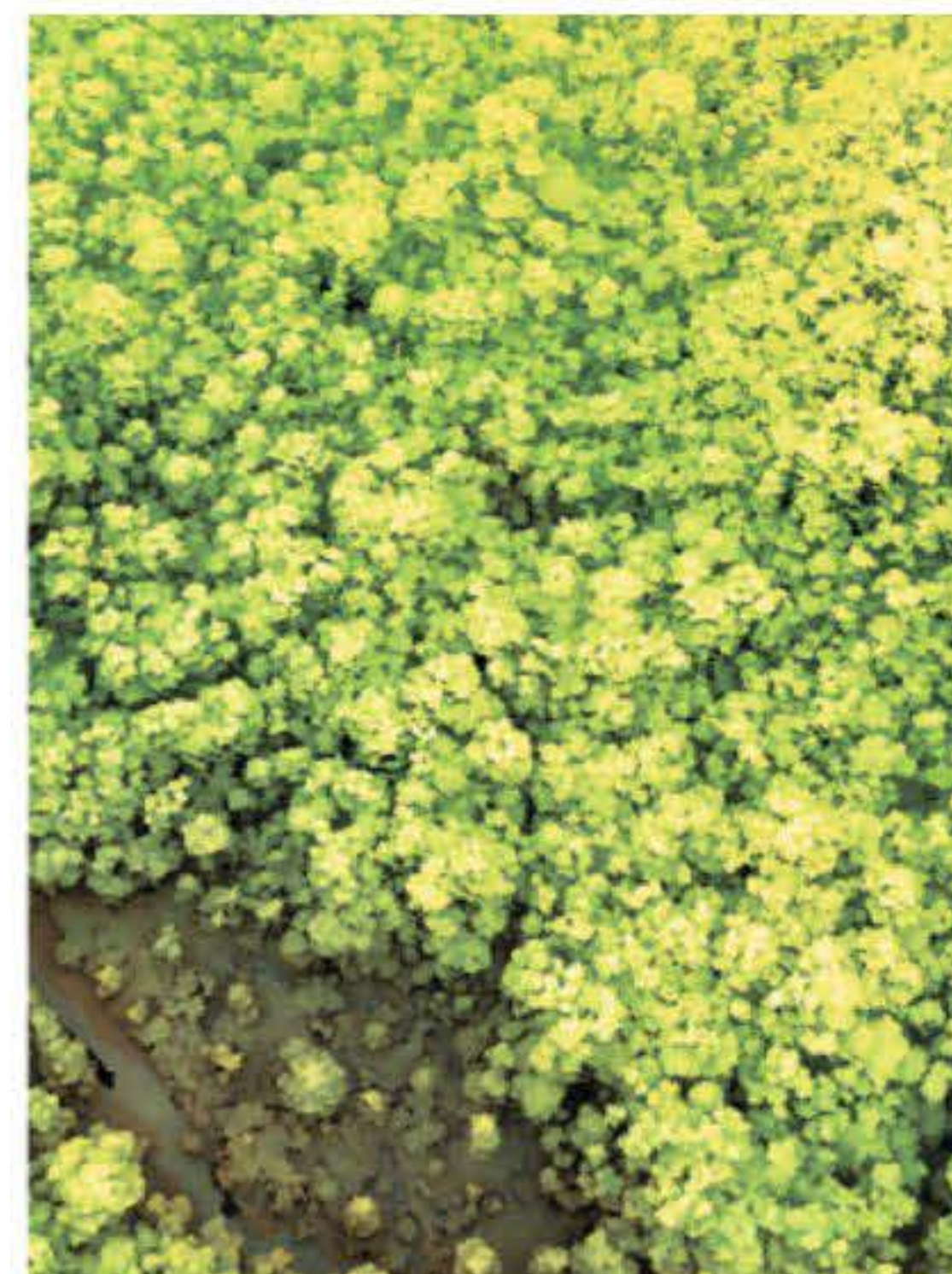
GROUND

RUINS

**EVIDENCE OF
RECTANGULAR,
MANMADE STRUCTURES**

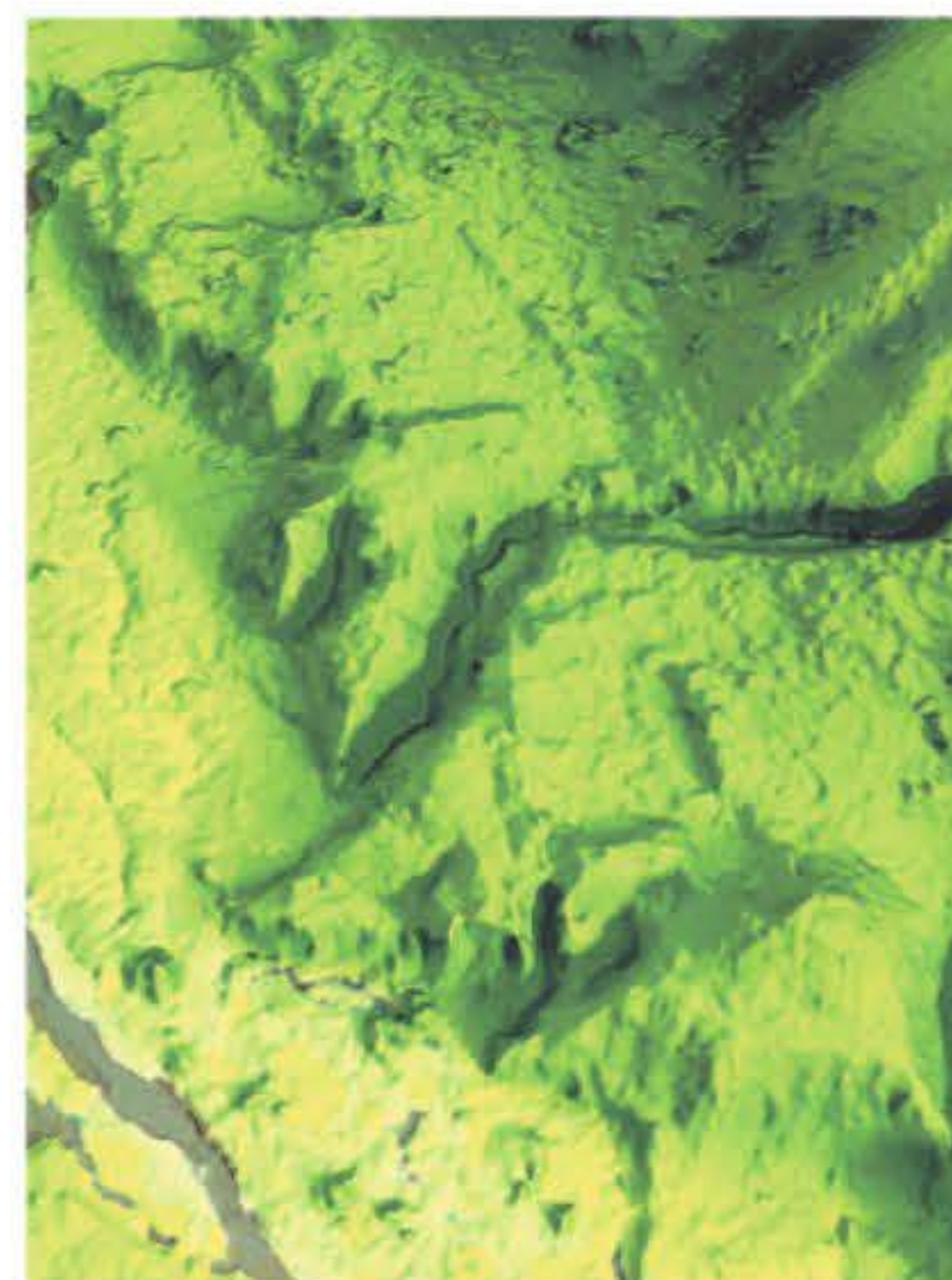
ENLARGED VIEW

NOT TO SCALE



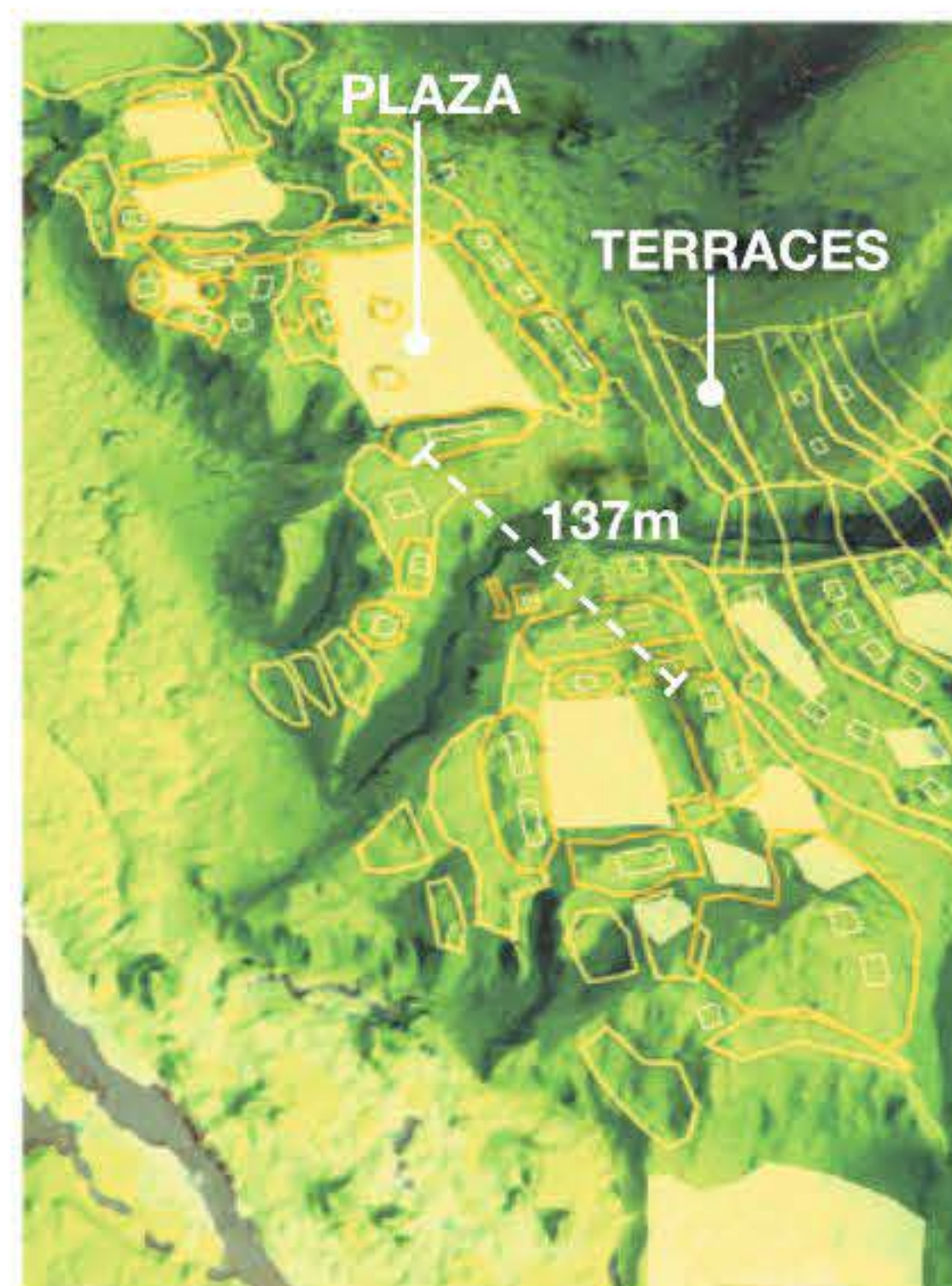
FREE VIEW

Special computer software is used to digitally strip away obstacles like trees or shrubbery.



3D MAP

What's left is a 3D topographic model of the ground, on which all geometric forms and shapes can be seen.



REVEALING TRACES

Experts then examine the 3D model. They're looking for changes to the landscape and evidence of manmade structures.

BUILDINGS

As most of the houses were built from wood and earth, they would later be dissolved by the rain and swallowed up by the thick vegetation of the jungle.

A CITY BECOMES VISIBLE

Using the LiDAR data and the research team's results, scientists were able to generate a preliminary map of the sunken city. The actual size of the structures illustrated can only be estimated as many are still hidden under the dense vegetation.

TERRACES

On the edges of the city, farmers cut terraces into the land. This made it easier to grow crops

PLAZA

There were ten large squares spread across the city. These appear to have been used for ritual ceremonies and public gatherings.

MOUNDS

Mounds of earth of various shapes and sizes are found throughout the site. It's likely they were the foundations of old temples.

CANALS

To irrigate the fields, a system of dams and canals was constructed on the edge of the city.

EARTHEN PYRAMID

DISCOVERY SITE

At the base of the pyramid, researchers discovered more than 50 artefacts, including pots, vessels and a decorated stone throne.

base camp while the helicopter collects the rest of the team from Catacamas. A few hours later Elkins and co are also standing in the middle of the ruins of the lost city...

IS AN ENTIRE CIVILISATION HIDING UNDER THE WHITE CITY?

Today the excavations are in full flow. The LiDar technicians have already scanned all of the artefacts and produced 3D images of them. "We believe there are even more treasures hidden in the ground," Fisher reveals. "Perhaps even the burial grounds of kings." These could shed important light on the culture that once existed here, as well as providing clues as to why people eventually deserted the city. Further scans are needed to figure out why that may have happened – and also to get a clearer idea of the true size and scale of the city.

Aside from venomous snakes and disease-carrying insects, there's another dangerous element that the team has to contend with: the region where the excavation work is taking place is ruled by drug cartels. Some 88% of the cocaine smuggled from South America to the US travels through Honduras. Historically, the country's jungle has been off-limits to the police and military. Drug



MILITARY PROTECTION

La Mosquitia is largely ruled by drug cartels, so the Honduran president Juan Orlando Hernández placed soldiers there to protect the archaeologists. The exact coordinates of the dig site are also kept top secret.

"We believe
that there are
more artefacts
lying hidden,
potentially even
the graves
of kings."

Chris Fisher, Archaeologist

traffickers have taken full advantage, clearing swathes of forest to build roads and landing strips or to create plantations to be used for money laundering. Keen to redress the balance, and ever mindful of the need for good publicity, Honduran president Juan Orlando Hernández has now placed the valleys under military protection. But according to Honduran archaeologist Virgilio Paredes these measures haven't stopped the smugglers, looters or loggers: "The president promised to protect this area, but he doesn't have enough money. If we do nothing this jungle will disappear within eight years."

The researchers face a race against time. The mapping of the valleys has only just begun, and a large number of ruins still lie undiscovered. Chris Fisher is convinced that they are a small part of a previously unknown culture and that many other lost cities lie hidden in the jungle. Perhaps the real White City has yet to be found. The fact is: they lie in the middle of one of the most dangerous and heavily fought over regions in the world, and the drugs trade will not stop for any ruins. Unlike Elkins, the traffickers are not dreaming of a White City, but of 'white gold': cocaine. The war for the lost city of Honduras has only just begun...



SEARCH FOR CLUES

Archaeologist Oscar Neil Cruz carefully uncovers the stone artefacts. Each one is scanned to produce a 3D model.

THE MOST DANGEROUS CYBER TERRORISTS IN THE WORLD

They are the **best**
hackers on the planet:
nobody has carried out more successful **attacks** on electricity grids
and no one has **cracked more data lines** than these troops

Wonderpedia uncovers
the **secret identity**
of the biggest threats to **public safety...**

...SOME OF WHOM YOU PROBABLY **KNOW ALREADY**

... I AM PUBLIC ENEMY NO. 1

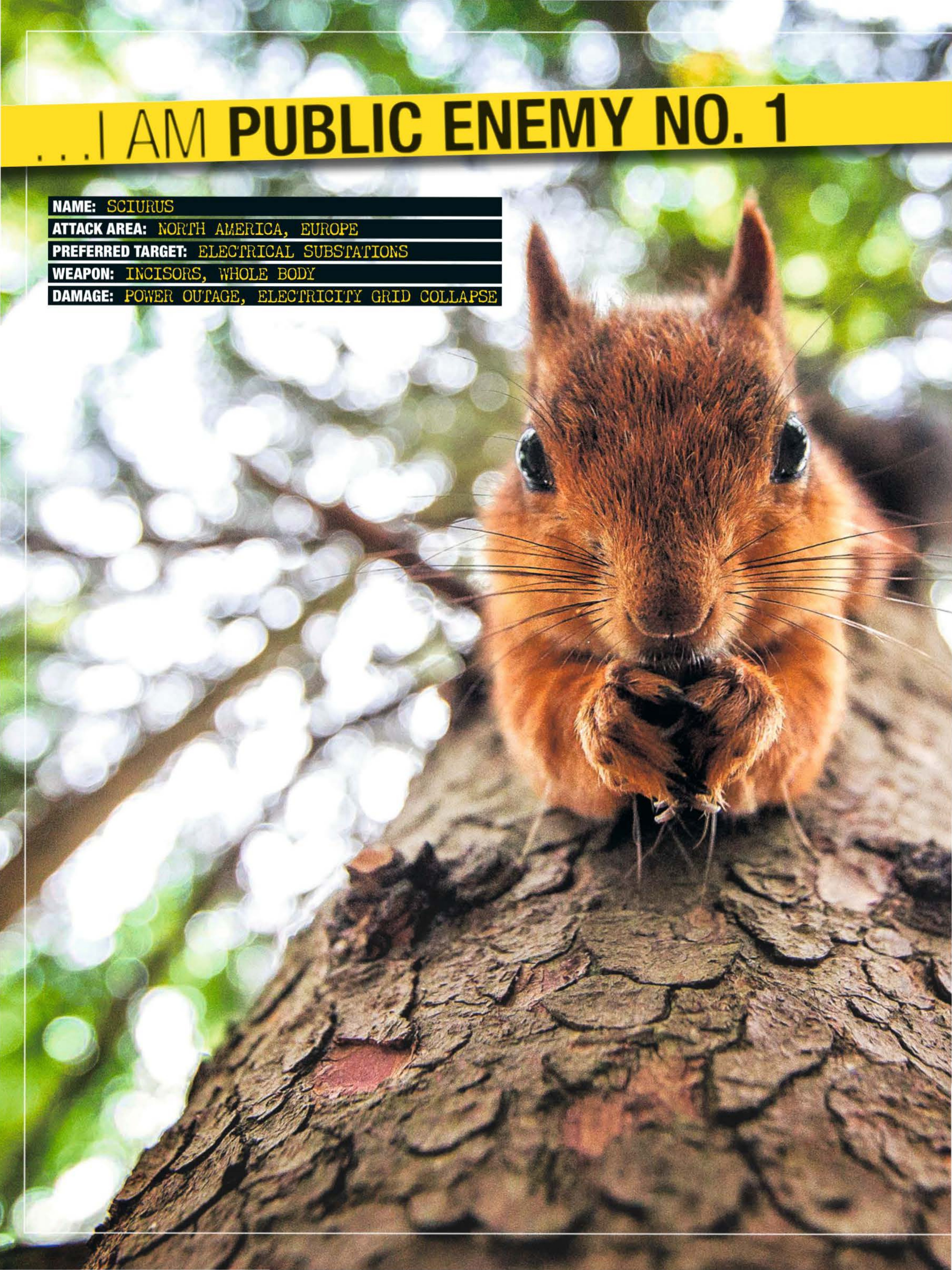
NAME: SCIURUS

ATTACK AREA: NORTH AMERICA, EUROPE

PREFERRED TARGET: ELECTRICAL SUBSTATIONS

WEAPON: INCISORS, WHOLE BODY

DAMAGE: POWER OUTAGE, ELECTRICITY GRID COLLAPSE





It's not the worldwide hacking collective Anonymous who are the most successful hackers in the world when it comes to our critical infrastructure – it's squirrels! Critical infrastructure includes a country's power stations, communication networks and other vital institutions. To date, human hackers have carried out just four successful cyber attacks of this kind, while the number of attacks by squirrels is at least 1,000 times that. Despite this, criminal hackers continue to dominate the headlines even though there is little evidence of the threat they pose being put into action. That's far from the case where squirrels are concerned, though: they carry out around 300 acts of vandalism a year in the city of Austin, Texas, alone.

No one can keep count of all their attacks – or

even estimate the number – because some last only a fraction of a second, causing a brief flickering of the lights at most. Yet these tiny creatures can have a big impact – they have already shut down Wall Street's NASDAQ stock exchange twice. In the city of Tampa, Florida, a squirrel bite led to a drinking water emergency lasting 37 hours, with residents forced to boil their water before consuming it. And in a transformer shed in Canada, a squirrel sparked a 3,000°C fireball, which cut off the electricity supply to an area the size of Britain for an hour. Cyber-defence bosses secretly admit that the four-legged hackers represent a huge problem: "The number one threat to the electricity grid is squirrels," says John Inglis, former deputy director of the National Security Agency. But danger doesn't just lie in the trees...



NAME: AURELIA AURITA

ATTACK AREA: BETWEEN THE TROPICS AND TEMPERATE LATITUDES

PREFERRED TARGET: POWER STATIONS NEAR THE COAST

WEAPON: TENTACLES, WHOLE BODY

DAMAGE: BLOCKAGE OF COOLING WATER, BLACKOUTS

WE STOP

NUCLEAR POWER PLANTS OPERATING



Nuclear power plants are some of the most secure facilities on Earth. To date, human hackers have caused no significant damage to them, although creatures without a brain have. In 2013, jellyfish began a mass assault that IT experts would probably call a denial-of-service (DoS) attack. A huge swarm of cnidarians blocked the cooling water

pipes of the Oskarshamn nuclear power plant on Sweden's Baltic coast, a station that provides 10% of the country's electricity supply. This caused one of the three reactor blocks to switch off for three days. Despite being 95% water jellyfish are a force to be reckoned with – power plants situated on the coasts of South Korea, Oman, Scotland and the US have already fallen victim to them.

NAME: AVES

ATTACK AREA: WORLDWIDE

PREFERRED TARGET: HIGH-VOLTAGE LINES

WEAPON: WINGS

DAMAGE: DISRUPTION OF TRANSPORT

I BRING THE RAIL NETWORK TO ITS KNEES



Birds perched on high-voltage power lines are a common sight. And as long as they just sit there, nothing will happen. But if a stray wing were to bridge the gap between another line or mast, several 10,000-volt stationary systems will short circuit. Even small amounts of bird droppings hitting the right spot can have the same effect. And what if the animal hackers attacked the rail network's overhead lines? Trains would stop and

the whole network would grind to a halt. A more common scenario is when a bird on a high-voltage wire catches alight after receiving an electric shock and falls to the ground: this can cause a huge fire. Meanwhile, to keep pigeons away, dummy models of their natural enemies (such as owls) can be installed. But that can lead to other problems: in at least one instance, a falcon has attacked such a fake owl, causing a power outage...



NAME: NYLANDERIA FULVA

ATTACK AREA: NORTH AND SOUTH AMERICA

PREFERRED TARGET: ELECTRICAL SYSTEMS

WEAPON: CHEMICAL MARKERS

DAMAGE: SHORT CIRCUITS, TOTAL FAILURE

WE CAUSE HAVOC IN A CHEMICAL FACTORY



Not all ants build nests and collect leaves – the Raspberry crazy ant likes nothing more than to swarm inside electronic matter: computers, fuse boxes and even entire power stations act as a breeding ground for the three-millimetre ants' offspring. "Perhaps because it's warm, perhaps because they can easily defend the small spaces," suspects Texan entomologist Roger Gold. The ants

nibble through insulation which can short-circuit electronics. If an ant is electrocuted, its body releases an alarm pheromone to communicate that they are in distress. The rest of the colony are then put into attack mode, leading to a rampage that often destroys entire electrical systems. One chemical plant saw the control system of its pipeline valves fail twice. The insects cause up to \$145 million of damage per year.





Memorial Day is one of the most important holidays in the US. Thousands of military parades take place as millions of people pay their respects to the country's fallen soldiers. Security services are on high alert as the day gives terrorists the perfect opportunity to strike at the very heart of the superpower.

Back in 2013, it seemed like everyone's worst fears had been realised. Sleeper cells had seemingly carried out perfectly coordinated attacks: in four US states, explosions occurred at critical junctures on the electrical grid. Tens of thousands of people were affected, stuck in lifts or traffic jams. Rumours of a large-scale hacker attack quickly spread. Who was behind it? Were the Russians to blame? The Chinese? Actually, the truth is somewhat more prosaic. The perpetrators were homegrown. What's more, they used neither computers nor explosives to carry out the attack – their weapons were their own four paws...

HOW DOES A RODENT TURN OFF THE ELECTRICITY?

Critical infrastructure – power grids, communication networks and traffic systems – forms the backbone of society. Tamper with them and civic order quickly breaks down. For

years, intelligence services have discussed possible ways in which hackers could bring a country to its knees. Governments allocate more and more resources to combat this supposed danger: "We face a cyber Pearl Harbor, a new 9/11," warned then-US Secretary of Defence Leon Panetta in 2012. "The greatest risk is a catastrophic attack on the energy infrastructure," General Keith Alexander, chief of the United States Cyber Command continued. "We are not prepared for that."

What's happened since then? Nothing. Or rather, the enemy is of a completely different kind. You see, it's not people behind the attacks, but curious animals: birds, jellyfish, ants and, above all, squirrels. Strictly speaking, the latter are the true architects of cyber-terrorism. In some US states, every second power outage caused by an

animal is down to the bushy-tailed beasts. They were also the culprits on Memorial Day, 2013. In contrast, there have only ever been three or four proven successful attacks on industrial installations by hackers using the internet. The reason? "That kind of cyber attack is very difficult," explains IT security expert Bruce Schneier. There's a huge amount of programming and expenditure involved in creating a virus, which only well-equipped and well-funded secret services can afford. And even then, it takes months or years to plan.

All of which is of no consequence to the terrorist group we know as 'Squirrels'. They don't need money to spread their influence. In fact the

group is so powerful that the Association of Energy Suppliers in the US has created its own activity log, which registers between 0.1 and 0.6 incidents per 1,000 customers every month. In California alone, these attacks cost \$300 million per year. "Typically, the animals touch current-carrying cables and a grounded component, such as a mast, at the same time, leading to a short circuit," explains Matthew Olearczyk of the Electric Power Research Institute. Sometimes it only lasts a fraction of a second and the power supply restarts automatically. At other

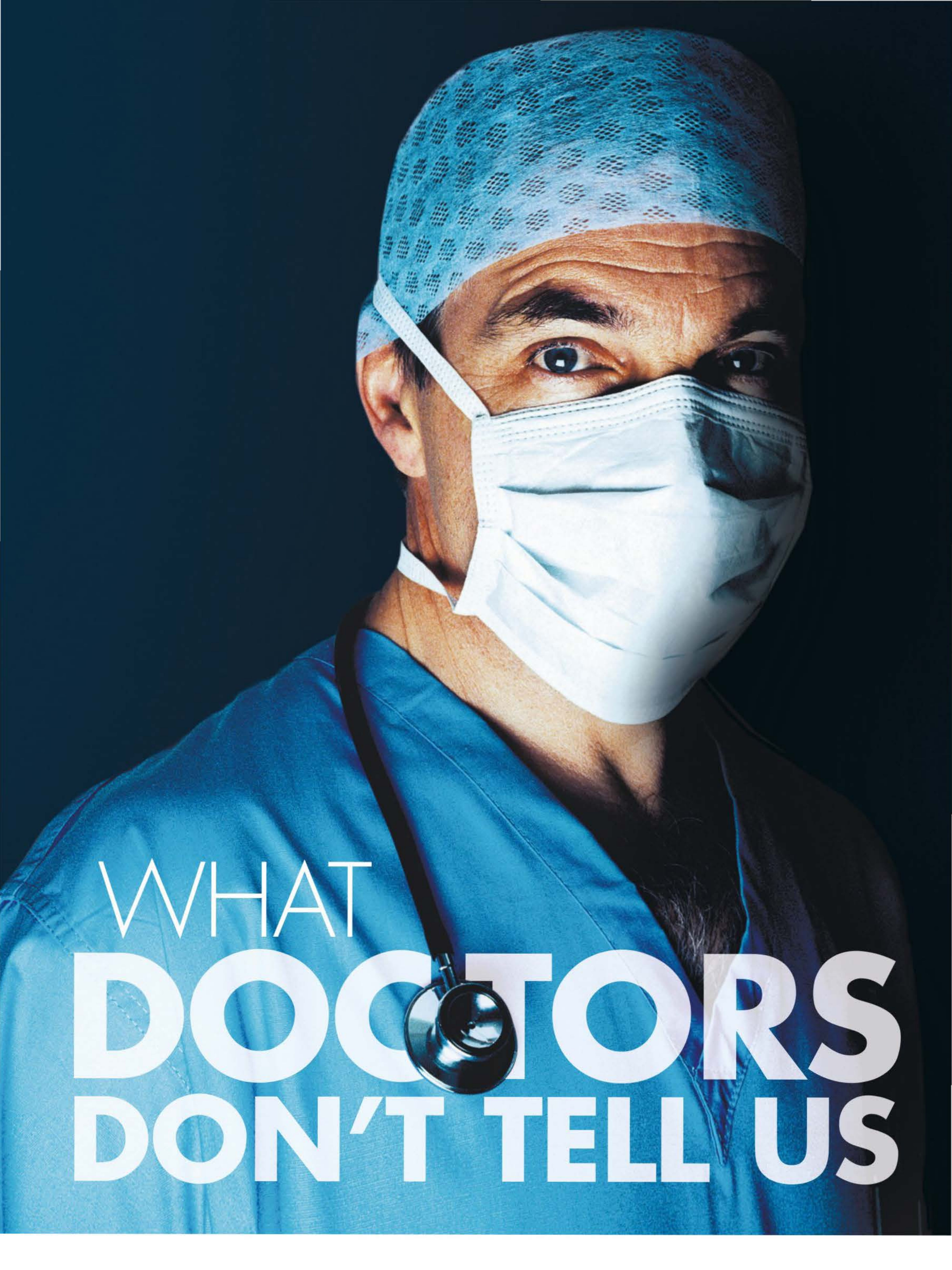
times the squirrel remains trapped in the short circuit position, so the system draws in more and more electricity to compensate. Subjected to temperatures of over 1,000°C, the squirrel explodes. That puts the facility out of action.

However, despite the dangers, the distributor stations still prove a huge draw for the animals. They offer shelter from predators, while the wind and cooling fans blow seeds and other foodstuffs into the installation. Plus there's always something there for them to chew on: "A squirrel's incisors grow 25cm per year – they have to constantly gnaw at things to wear them down," explains University of Arizona zoologist John Koprowski.

Authorities have tried everything: bars on windows, strategically-placed dummies of pine martens, even fox urine, but nothing has stopped the creatures from hacking US infrastructure. The army of furry terrorists goes marching on...

"THE NUMBER ONE THREAT TO THE US POWER GRID IS SQUIRRELS"

JOHN INGLIS, FORMER DEPUTY DIRECTOR OF THE NATIONAL SECURITY AGENCY (NSA)



WHAT
DOCTORS
DON'T TELL US

Which medicines claim more lives than they save?
How is a disease invented?
What criteria is used to decide who receives a donor organ? *Wonderpedia* explores the dark secrets of medicine...

The contract does not require a signature, a spoken agreement or even a handshake to be valid. It automatically comes into force every time you set foot in the doctor's surgery. The 'contract' between doctor and patient states that every doctor is obliged to provide their patient with clear information, to treat them to the best of their ability and to keep them out of harm's way. But what many people don't realise is that doctors break this contract every single day. Often unwittingly, but sometimes deliberately. There are three main reasons for this:

1. IGNORANCE: Even the most groundbreaking of medical findings can take several years to filter through to frontline doctors. An example: for three decades, studies have found that the sedative diazepam (Valium) is as addictive as heroin – yet it is still being prescribed to millions today.

2. DISHONESTY: "What would you do if you were in my shoes?" Many doctors dread this question and fail to give an honest answer or offer patients their true personal opinions. An example: a survey carried out at Duke University in North Carolina asked doctors whether they would recommend their patients undergo the same bowel cancer treatment that they would choose. The findings alarmed even the experts: of the 500 physicians surveyed, a staggering 40% advised their patients to have an operation that they would personally reject because of the many negative side effects.

3. MISINFORMATION: In reality, more than 50% of funded drug studies are influenced in favour of the pharmaceutical firms that finance them. Joel Lexchin of York University, Toronto, analysed 30 reports on research funded by drug companies and found that they were four times more likely to be positive than independently funded studies. "We found that in almost all cases there was a rather heavy bias in favour [of a drug] when the study was industry funded," he said. That means doctors often rely on biased research, but this is rarely communicated to those being treated. Sometimes doctors don't realise this themselves.

Now one organisation has declared war on this issue. The Cochrane Collaboration is a network of physicians and scientists that has been operating for the last 20 years. During that time it has developed into an unofficial quality control institute for medical products and trials. The group's name and ethos are inspired by Dr Archie Cochrane, one of the founding fathers of 'evidence-based medicine'. The researchers' aim is to filter the unbiased and diagnostically conclusive results from studies commissioned by pharmaceutical companies eager to get their medicines to market. To prevent this, systematic checking and comparing of different studies aims to control the efficacy and risks of a drug – and the health of patients as a result. Today, 37,000 scientists in 100 countries contribute to the Cochrane Collaboration as unpaid volunteers. Their goal: making sure medicines actually benefit patients. "Some of the treatments I had been taught to give at medical school were actually harming, and sometimes killing, my patients," says the organisation's founder, Sir Iain Chalmers. "With the best of intentions, doctors and other health professionals can do harm. Everything starts from that."

On the following pages Wonderpedia, aided by leading independent medical experts, reveals how medical trials can be influenced, which information doctors would rather keep secret and how some doctors put at risk the most important commodity a human being possesses – their health...

JUST HOW DANGEROUS IS THE FLU?



Every year, thousands of people fall victim to it in the UK – around 21,000 on average, according to analysis of figures for the last five years by Public Health England. This makes the flu an epidemic that claims more lives in the UK every year than the recent Ebola epidemic in the whole of West Africa. It's a serious matter when the media, health insurance firms and the WHO all call for people to get a seasonal flu vaccination. The official line from the Department of Health is that "this is the best protection we have against an unpredictable virus." Most doctors recommend their patients get a flu jab – and millions heed this advice, despite possible side effects like headaches, sore throats and muscle and limb pain.

The flu vaccination would be seen as a true success story for the health and wellbeing of the nation – were it not for one stark fact withheld from patients: **it is entirely possible that flu vaccines have no effect at all.** In reality there are a number of critical studies that raise doubt over the official line on flu vaccinations. A meta-analysis by the Cochrane Collaboration reviewed 36 individual studies and discovered that the annual flu vaccine had no proven effect on severe complications or the number of flu-related hospital admissions. Margaret

McCarthy, a GP based in Glasgow, has also flagged doubts about the effectiveness of flu vaccinations: "There is a lack of 'quality evidence' available on flu vaccination: the bottom line is we need better quality of evidence." Studies

"There is not enough evidence to decide whether routine vaccination to prevent influenza in healthy adults is effective."

THE COCHRANE COLLABORATION

have also shown that you need to vaccinate 100 people for just one person to benefit.

The Cochrane researchers also had problems with the official definition of a certain at-risk group: infants. The Center for Disease Control and Prevention in Atlanta, Georgia, downgraded the vaccine

recommendation for children to six months. Their reasoning: there have also been many cases of flu in children – though an exact statistic related to infants is lacking. The Cochrane Collaboration found it strange that of the 52 studies they collected on flu infections in children, only two occupied themselves with infants.

And these could not prove the vaccine's efficacy. In fact, there was only one study which concerned itself with the safety of vaccines: it was over 30 years old and only studied 35 infants.



HOW ARE FLU DEATHS COUNTED?

Flu deaths are difficult to count as deaths are recorded as resulting from pneumonia or a secondary condition. This means Public Health England has to base its flu mortality figures on estimates. To arrive at a number you subtract the summer deaths from the more numerous winter deaths and call what's left over 'excess mortality'. Although this fatality rate can never exactly match the true number of influenza deaths, it serves as the basis for estimating 'flu-related excess mortality'. The year 2009 was an exception because that was when swine flu was spreading through Europe. Authorities were obliged to report all deaths. The surprising outcome: only 214 documented swine flu deaths in the UK.





CAN A GRAPEFRUIT KILL ME?



In the UK thousands of medicines are licensed for use. In fact, 50% of women and 43% of men

in England are now regularly swallowing prescription drugs. To treat something as mundane as a common cold, you can now get hold of half a dozen drugs over the counter that can be administered at home. The problem: **it doesn't matter how harmless an active ingredient is – when it interacts with another substance, a chemical reaction takes place.** And the effects of this interaction can be serious: drugs change their composition, cancel each other out, have the opposite of their desired effect or even increase in strength so much that they become poisonous. It's a risky Russian roulette that doctors have been warning about for years – particularly in the case of self-prescribed treatments. What they fail to mention so often: drugs don't just react with other medicines – but

with anything that has a chemical effect on the body. And that includes food.

A typical day at a GP's surgery shows the extent to which doctors are ignoring this risk. As a rule, prescribing physicians won't usually ask about a patient's eating habits even though the influence of foods on the metabolism – the body's own chemistry set – is indisputable. It's a similar situation with standardised patient forms. These will normally only ask about previous illnesses, medications or pregnancy. But what about food? No chance – even though doctors know that something as ubiquitous as fruit can quickly become dangerous. For example, furanocoumarin, found in citrus fruits like grapefruit, has a significant effect on the breakdown of medicines in the human body. This can quickly turn a harmless dose into a deadly one. This drug interaction has claimed lives: in the 1990s a 29-year-old American died after taking hayfever medication while also drinking a few glasses of grapefruit juice a week. The amount of the drug in his blood increased 30-fold, causing circulatory collapse.

Beer, salami or mature cheese can be similarly dangerous. The reason: as these foods age, they build up large amounts of the substance tyramine, which can raise blood pressure. If you are also taking monamine oxidase inhibitors for anxiety or depression, the breakdown of tyramine will be affected. The consequences: headaches and dangerously high blood pressure. **Another example affects the 5.4 million UK citizens with asthma.** That's because some asthma drugs contain theophylline. If that comes into contact

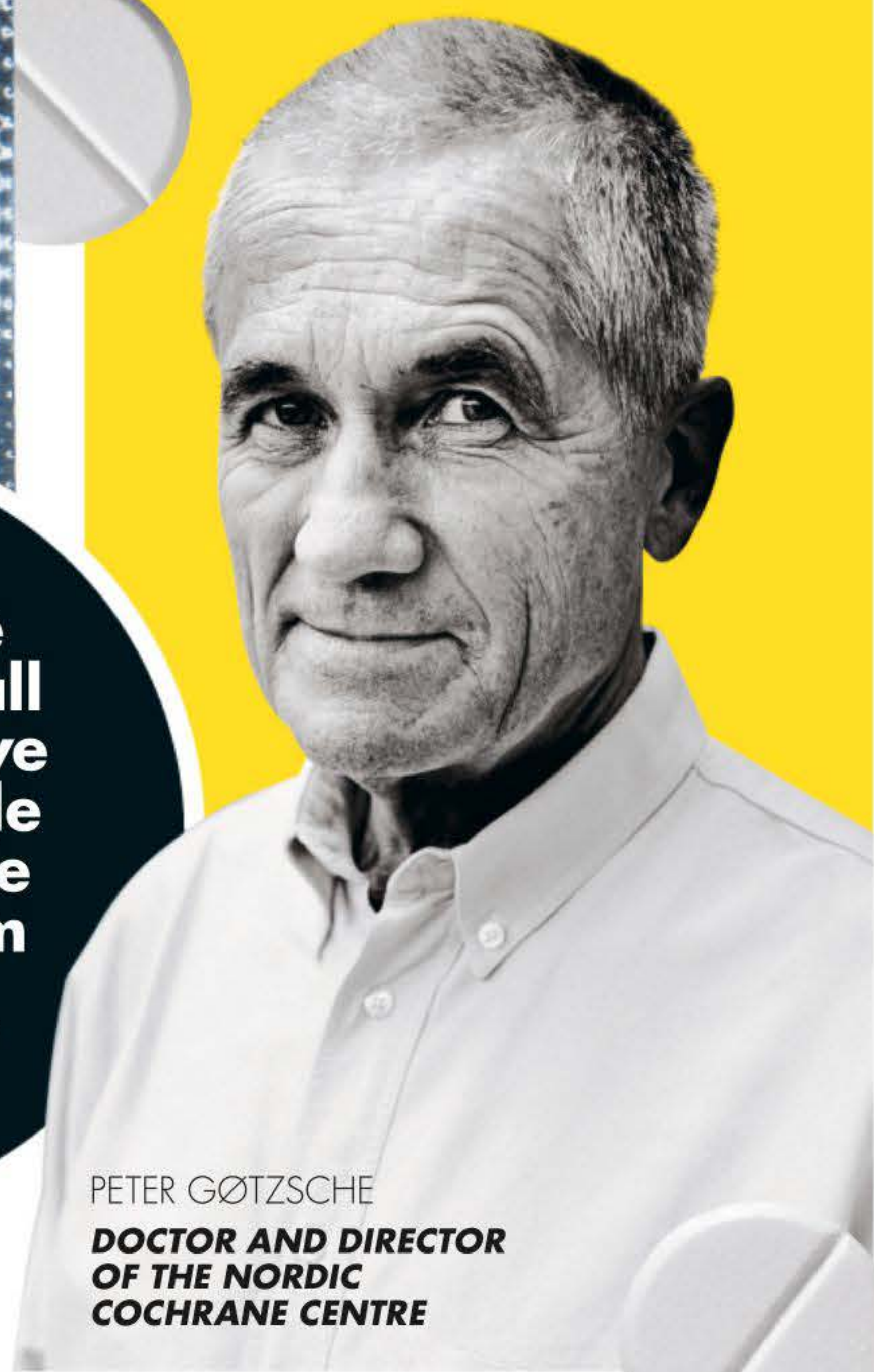
"Adverse reactions to medicines are implicated in up to 6.5% of hospital admissions."

DR MARTIN DUERDEN,
BANGOR UNIVERSITY

with black pepper, the medicine reacts with piperine – a naturally occurring compound in pepper – and the level of theophylline in the blood increases. Possible symptoms: heartburn, anxiety and an irregular heartbeat.



"The terrible thing is that all medicines have damaging side effects – while many of them are also ineffective."



PETER GØTZSCHE
**DOCTOR AND DIRECTOR
OF THE NORDIC
COCHRANE CENTRE**

DO MEDICINES CLAIM MORE LIVES THAN THEY SAVE?



More than one billion medicines are passed over the pharmacy counter every year in the UK. But what hardly anybody outside of the medical profession realises: prescription pills are Britain's third-biggest killer. Of course, there's no doubt that these drugs save countless lives. But what many doctors fail to mention is that taking any medicine, even something as common as a painkiller, poses a hidden – and deadly – risk. **"The most common side effects and complications are caused by those medicines that are also prescribed most regularly,"** says Keihan Ahmadi-Simab, a medical director based in Hamburg. And therein lies the problem, say medical experts. Something that is handed over by your friendly local chemist will appear harmless, which lulls users into a false sense of security – oblivious to the fact that all drugs

have side effects and carry the risk of complications.

One significant example comes in the form of anti-depressants. Britain has been described as a 'Prozac Nation' with one in 11 British adults taking some form of anti-depressant medication. Despite their widespread use, their effects are far from proven. Dr Joanna Moncrieff from University College London says: "People in the UK are consuming more than four times as many antidepressants as they did two decades ago. Despite this, we still do not fully understand the effects of these drugs." What's more: anti-depressants come with a long and worrying list of side effects. Peter Gøtzsche, director of the Nordic Cochrane Centre, noted that antidepressant and antipsychotic medications in America and Europe are responsible for the deaths of more than 500,000 people aged 65 or older every year. The main culprits,

some experts believe, are selective serotonin reuptake inhibitors (SSRIs). Debate has raged in professional circles for years due to the suspicion that these drugs actually *increase* a person's risk of suicide. Many experts believe that this is directly related to the way the drugs actually affect the brain. They help people suffering from depression become more active and able to overcome their lethargy. The problem: **the drugs give every thought or plan more energy, including suicidal intentions.** If the patient harboured suicidal intentions before the treatment began, taking an anti-depressant might motivate them to act on their urge. This is corroborated by the fact that it's within the first nine days of SSRI treatment that a person is most at risk of suicidal behaviour. The problem is, other anti-depressants also have side effects and alternative treatments are currently thin on the ground.

WHICH CRITERIA REALLY DECIDE WHO RECEIVES A DONATED ORGAN?



In the UK there are more than 7,000 people on the national transplant waiting list. But though there are over 500,000 deaths a year on these shores, fewer than 5,000 people die in circumstances where they are eligible for organ donation. This means that the waiting time for individuals desperate for an organ is extremely long. On average, a person waits two to three years for a kidney and over a year for a heart. So does your chance of receiving an organ increase the longer you're on the waiting list? Not necessarily: because when speaking to seriously ill patients, some doctors are not completely honest. Alongside the 'hard' criteria that determine whether a donor organ is right for a patient, such as a person's blood type and age, there are also numerous 'soft' criteria that play a crucial role in the allocation of organs.

For example, many of those affected do not realise that the ranking of patients on the

transplant list is calculated anew for every donor organ that becomes available. This means a patient might be second on the list in one case, but right at the bottom in another, depending on blood type and specific circumstances.

But even if the dice are rolled in the patient's favour, they will not automatically be selected for a transplant – far from it. In fact it doesn't even mean they will get a new organ at all. How can that be the case? In a nutshell: once the list of patients eligible for a kidney transplant has been whittled down to just two using the hard criteria, there's a dilemma. For the estimated 40,000 people waiting for a kidney in western Europe, it is a problem that occurs more frequently than many would believe. To select a patient for an organ in this instance, doctors must also take soft criteria into account. These are often based on subjective assessment. The

doctors responsible must decide on an organ recipient using factors like lifestyle or likeliness to keep up with the gruelling anti-rejection drugs regime required after the transplant – and it's a maddeningly difficult task. In practice that might mean that a 47-year-old has a lower chance of being allocated a donor liver than a 17-year-old with a genetic condition who is otherwise healthy. For critics

"Why transplant medicine is not subject to certain disclosure obligations is a mystery to me."

PAOLO BAVASTRO,
CARDIOLOGIST

that's a bitter pill to swallow: without objective criteria, they believe a red line is crossed. Patrick McMahon, a transplant coordinator, has even accused doctors of "playing God".

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PRINCIPLE: BRAIN DEATH

Despite it being a commonly-held misconception, dead people cannot donate organs. "You can only transplant organs that are living," explains cardiologist Paolo Bavastro. So that doctors can remove organs from a living corpse without becoming liable, an alternative definition of death came into force in 1968. It is defined as when the brain is no longer functioning and will never recover, even though other parts of the body may still be active or kept alive by life support machines. There are only 5,000 cases of brain stem death in the UK per year.



ARE DRUG STUDIES MANIPULATED?



"The manipulation of clinical studies is so widespread and so serious that you should only consider the reports on these studies as advertisements for medical drugs," says Professor Peter Gøtzsche, director of the Nordic Cochrane Center in Copenhagen – a statement that is sure to make him some enemies. These are extremely harsh words, directed not only against the pharmaceutical industry but also against those doctors and researchers who remain silent on the matter. The truth is: that's what most doctors do. But what does that mean for patients?

New research has found that clinical trials and research funded by pharmaceutical companies is more likely to produce results that are biased in favour of the sponsor's medicine. Joel Lexchin, a Toronto doctor, analysed 30 reports examining pharmaceutical industry-funded research and found that the studies were four times more likely to be positive than research funded by independent sponsors. "What we found was that in almost all cases there was a bias – a rather heavy bias – in favour [of a drug] when the study was industry funded," said Lexchin. In actual fact, pharmaceutical companies don't need to invent or make up results – it's enough to weigh facts differently or leave them out entirely. Positive studies are far more

likely to be published than negative ones. And even seemingly small differences can "represent billions of dollars on the world market," says Gøtzsche. The principle, nonetheless,

"The pharmaceutical industry spends twice as much on advertising as it does on research and development."

DR JOEL LEXCHIN,
YORK UNIVERSITY OF TORONTO

seems simple: those who have the financial clout decide the results, something confirmed by random spot checks carried out by the Cochrane Center. These showed that at least 50% of funded drug studies financed by pharmaceutical companies are influenced in their favour. However, such manipulated studies do not

stand in the way of drugs being approved – because to date there are "neither cross-disciplinary standards for the peer review process, nor measurable quality criteria" according to Professor Flaminio Squazzoni from the University of Brescia in Italy.

The real scandal, however, is that it is no secret. **According to research carried out by the Cochrane Collaboration, tens of thousands of manipulated studies have been published.** Doctors should know about this. They have a huge responsibility to their patients, who expect them to be informed about significant medical developments, particularly when these pertain to a drug that they prescribe. But history shows that many drugs or treatments continue to be prescribed even though studies no longer support their use. Consider PSA tests for the early diagnosis of prostate cancer. Even the

man who developed them, Dr Richard Ablin, now advises against their use because most of these cancers are slow-growing and do not require treatment. But doctors continue to use them. The same is true of the sedative diazepam (Valium). Although it's been known for 30 years that the drug is as addictive as heroin, it is still prescribed.





ARE WE GUINEA PIGS?

To better monitor the effect of drugs, pharmaceutical companies in Europe invest around €100 million a year in so-called observational studies. These see doctors prescribing a particular drug and documenting its effects. But is the process really helping to make prescription drugs safer? Many experts doubt it. The medical benefits of these covert studies is low, while the fees paid to doctors are high. For Professor Karl Lauterbach from the University of Cologne, this imbalance is clear evidence that observational studies entice doctors into prescribing certain medicines more often than others. Against this background it's also problematic that in some countries neither the state nor the insurance companies monitor the connections between doctors and the pharmaceutical industry. In the UK people running clinical trials have legal obligations that are set out in the Medicines for Human Use (Clinical Trials) Regulations 2004.

ARE CHIROPRACTIC TREATMENTS INEFFECTIVE?



Patients in the UK are regularly convinced by their doctors to try out

complementary treatments or alternative therapies. What the doctors often fail to mention, however, is that the medicinal value of such treatments is – from a medical perspective – unclear. In spite of this, business in alternative therapies is booming. What's significant: **the process is virtually identical in most instances. Initially, a particular treatment method sees heavy investment from the industry, unions or doctors. Often millions of dollars is spent on advertising and marketing campaigns – until suddenly, as if from nowhere, a new 'health trend' emerges.** This ensures profits for as long as research on the trend continues – or until it is proved or disproved in studies.

One example is chiropractic treatment. It is sold to patients as a gentle alternative therapy for spinal issues.

Chiropractors claim that, alongside a healthy diet and behavioural therapy, targeted manipulations of the spine can help to cure many illnesses, from back pain to asthma to migraines. But the healing power of chiropractic treatment began to unravel some time ago. One of the leading experts on alternative treatments is Edzard Ernst from

the University of Exeter. In 2008 he concluded that chiropractic treatment methods are based on junk science. They can even be deadly. "Several hundred cases have been documented in which patients were seriously and often permanently damaged after chiropractic manipulations. A 32-year-old woman from Jakarta died after being treated by an American chiropractor. What usually happens in these tragic instances is that, upon manipulation of the upper spine, an artery supplying the brain is over-stretched and simply breaks up, leading to a stroke which can prove fatal."

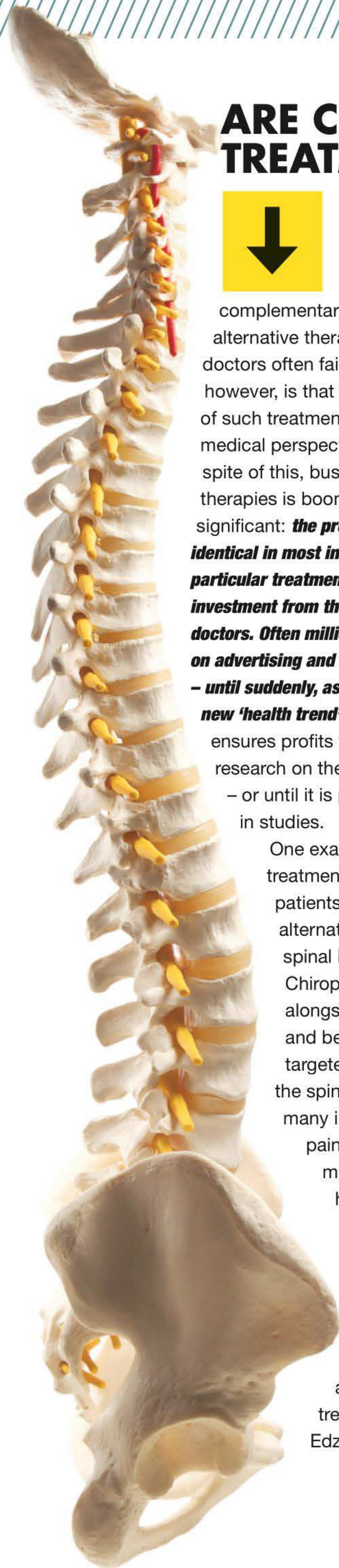
In another study Professor Steven Novella from Yale University checked

"There is now a lot of evidence showing that more than half of all patients suffer mild to moderate adverse effects after seeing a chiropractor."

PROFESSOR EDZARD ERNST,
UNIVERSITY OF EXETER

27 studies that praised chiropractic therapy – and reached a devastating conclusion: "The best thing the list had to offer were weak and poorly designed studies. Moreover, the association ignored better, larger studies that found negative results."

Despite the proven lack of evidence for such alternative therapies, the phenomenon looks set to continue for some time. History shows that the creators of such fads tend to fight to the last for their lucrative money-spinners. They often resort to lawyers instead of engaging in constructive scientific debate – which tells you all you need to know...



ARE DIETS ACTUALLY UNHEALTHY?



Catherine can hardly believe her eyes: “Diet industry shocked!” reads

the ad banner on her computer monitor. “The new wonder drug that can help you reach your dream weight in just two weeks!” The advert looks genuine. Catherine clicks on the link and lands on the homepage of an online shop for health products. The diet pills are being touted as a new miracle cure from the US. Sounds good. Perhaps too good. Suspicious, Catherine makes an appointment to see her GP later that day. For eight years he has been treating her obesity – though she hasn’t lost any noticeable amount of weight. He too is suspicious and counsels her against using them. Instead, he advocates a healthy, balanced diet – again. She could do that easily, she thinks, if only she wanted to. But what he doesn’t say is that, in one particular instance, being overweight could actually save Catherine’s life...

Even if medical training and long-held beliefs say otherwise, being overweight is not always a disease that a person needs to be ‘cured’ of. In fact, the opposite may be the case. A meta-analysis of 36 different coronary heart disease studies by Dr Abhishek Sharma of New York State University found that heart disease patients with an above-average BMI (classed as “overweight”) had a lower risk of dying from cardiovascular disease than patients with a normal BMI.

Another thing Catherine’s doctor might have mentioned: the failure of a diet has nothing to do with the

willpower or determination of the patient. It’s down to a physical process known as the ‘famine reaction’. “When you start losing too much weight too quickly, the body brings on this defence mechanism to protect you from wasting away,” explains Amanda Salis from the University of Sydney. Put simply: the brain cannot differentiate between a voluntary lack of food due to a diet or an involuntary one due to, say, a

“It is clear that obese patients with heart disease respond well to treatment and have paradoxically better outcomes than thinner patients.”

DR CARL J. LAVIE,
CARDIOLOGIST

famine. If it does not get enough food, it thinks there’s an emergency – and starts to put its emergency

plan into action. It increases appetite and feelings of lethargy, and, crucially, reduces metabolism. Side effects could also include back pain, depressive thoughts, muscle and bone weakness or memory problems. Salis warns: “The important thing to note with these types of diets is that they need to be done under medical supervision. I always shudder when I see people going to the pharmacy to buy some kind of liquid or detox diet. They just buy something off the shelf and do it themselves. This is a really dangerous thing to do because unless you’ve got perfect kidney and liver function, you can get into a lot of trouble with very low-calorie diets.” And the same goes for those diet pills, says Salis. The reason: tinkering with the body’s metabolism is extremely risky and under-researched. For this reason slimming pills will probably never be approved for use.



HOW DO YOU INVENT AN ILLNESS?



It is a widespread disease, practically an epidemic – and it has appeared out of the blue. An estimated four million Britons suffer from the symptoms of a gluten intolerance. Latest figures reveal that as many as one in three Americans avoid gluten, the protein found in wheat, barley and rye. Doctors are increasingly diagnosing the allergy – but they often fail to tell their patients the most important thing: the existence of such an intolerance has never been proven. Diagnoses can only be made indirectly: if other intolerances can be excluded, then gluten is probably to blame. And because doctors are not entirely sure whether this condition actually exists, a gluten intolerance is practically an invented condition. This is in contrast to coeliac disease, an auto-immune disorder marked by inflammation of the gut. Sufferers of this must avoid gluten religiously.

Researchers believe that only one in 20 'gluten avoiders' suffers from a genuine intolerance. The winners of this fad? The food industry, which has developed an entire range of foods for the gluten-intolerant among us.

That's not all. Aside from relatively innocuous food intolerances, the list of invented diseases is growing ever longer. There's even a name for the practice: disease mongering. An example is 'Sissi syndrome', a form of depression marked by mood swings and low self-esteem. But the condition is entirely invented. Science journalist Jörg Blech claims that the disease wasn't discovered by a doctor – but in a pharmaceutical company's marketing department. The firm wanted to increase sales of a new anti-depressant, and they needed a disease to fit the drug. But why go to this immense effort?

"As far as the pharmaceutical industry is concerned, the wrong people normally get ill – that's to say the poor and the old,

who have a shorter life expectancy," explains Professor Karl Lauterbach. For that reason many pharmaceutical giants have been putting the spotlight on diseases that are easier to carry over to those who can pay, and for longer – something that's easiest to do with diseases directly designed for the corresponding target group. "In this system doctors have become the

"Striving for health is something innate in humans. But the disease inventors exploit that."

JÖRG BLECH,
SCIENCE JOURNALIST

accomplices to the industry," says Blech. That's because expensive advice sessions or individual healthcare not covered by insurance is one thing above all others: a lucrative market. "Sending patients home doesn't earn you any money," he adds.

"The lack of knowledge among doctors and chemists continues to shock me. Results from scientific studies often only come into practice years later."

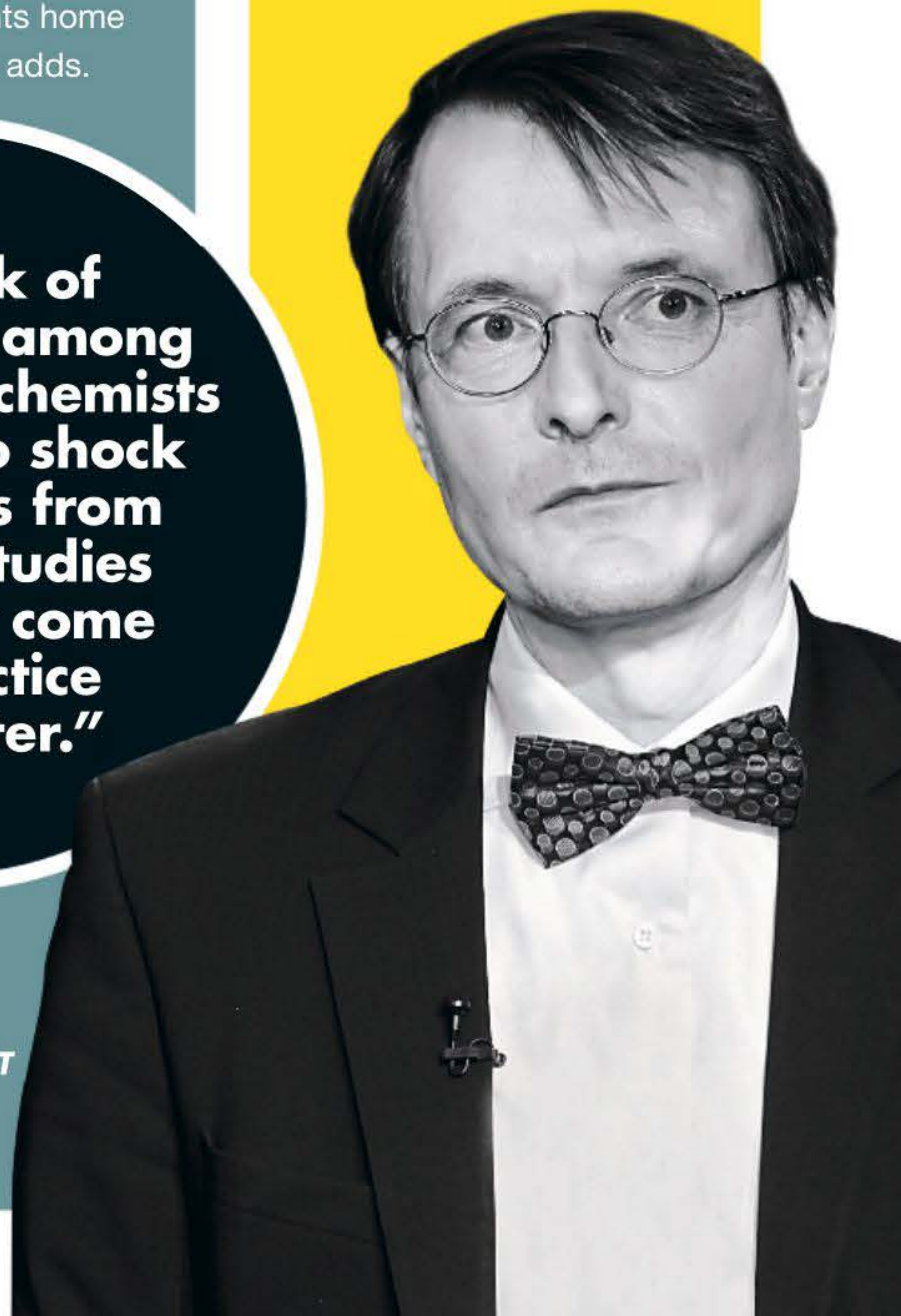
KARL LAUTERBACH
POLITICIAN AND PROFESSOR AT
THE UNIVERSITY OF COLOGNE

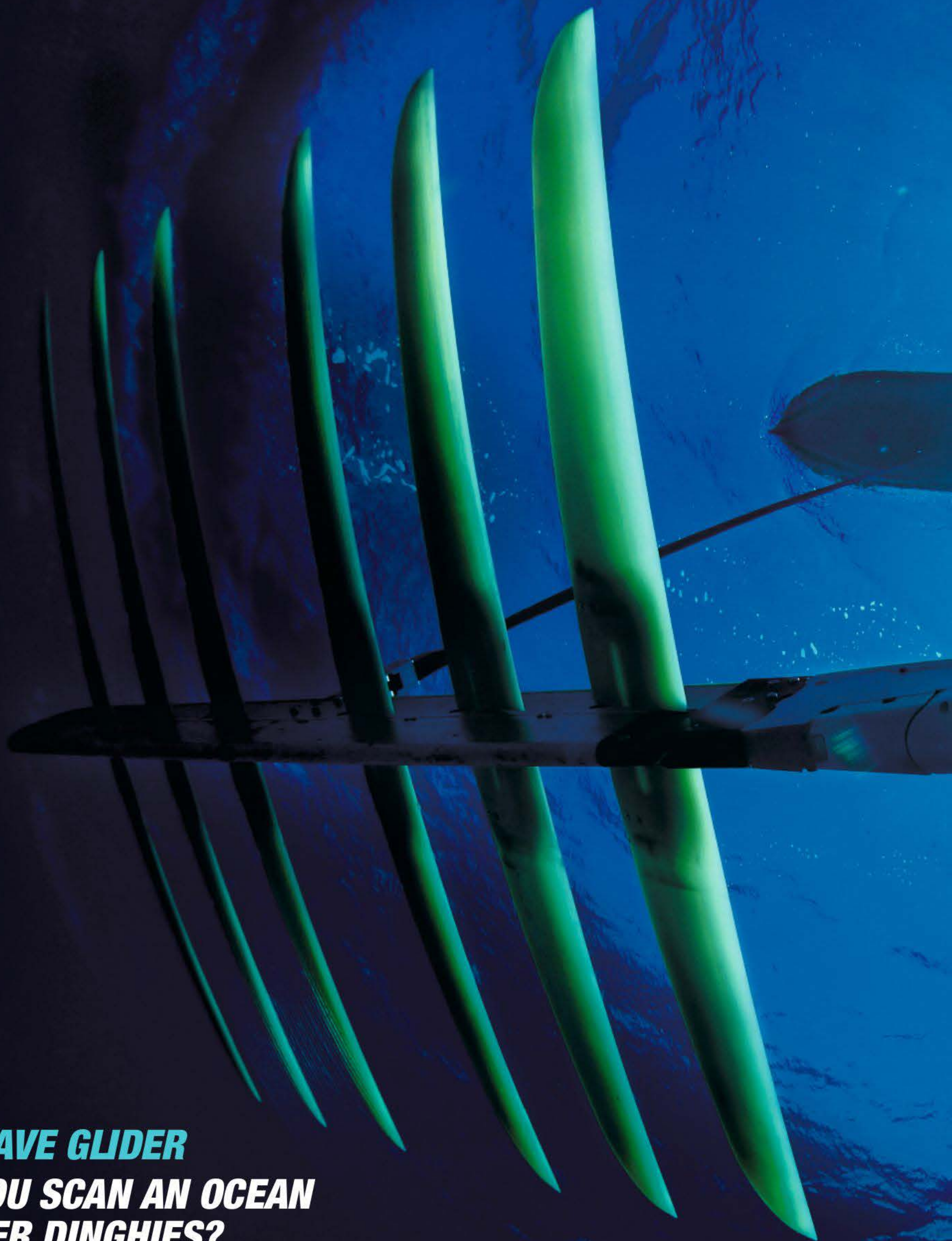
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GRIEF OR DEPRESSION?

Some illnesses don't need to be invented. Lowering or redefining their eligibility criteria is enough. For example, the criteria for diagnosing depression were much stricter 20 years ago than they are today.

According to the Diagnostic and Statistical Manual of Mental Disorders, which classifies psychiatric conditions, a diagnosis of depression can be given two weeks after a bereavement. Historically, that period was set at two months, and before that at a year, because grieving people often exhibit similar symptoms to those suffering from depression. The result: people who simply need time to recover from grief are quickly declared as patients and treated as such.





Project: WAVE GLIDER ***HOW DO YOU SCAN AN OCEAN FOR RUBBER DINGHIES?***

■ Every day thousands of refugees set sail on a perilous journey across the Mediterranean to Europe. The size of the boats they use mean only a fraction are detected by satellites, while they easily slip under the radar of patrol ships. This is what the so-called Wave Glider is aiming to counter. And the underwater drone is not some project for

the distant future – quite the opposite. The autonomous mini subs can be kitted out with a passive acoustic sensor to scout the ocean for boats exhibiting ‘abnormal behaviour’, and are already being tested in the course of a mission by the EU border agency Frontex. Part of a state-of-the-art software suite, the sensors are

designed to acoustically detect and track suspicious waterborne sounds, which are then transmitted to a command and control centre on the mainland. In the future this could allow unseaworthy refugee boats to be tracked down in international waters and then collected back by the patrol boats of the countries from where they set sail.

An underwater photograph with a deep blue color palette. A bright, circular light source, possibly the sun, is visible near the surface, creating a strong lens flare and illuminating the water. In the lower-left foreground, the dark silhouette of a diver's fin is visible. The water surface is textured with ripples and bubbles.

Why build a FENCE?

Spring is expected to bring a fresh wave of refugees to Europe. But while they prepare for their perilous journey, politicians are busy looking at ways to beef up security on Europe's borders. Ideas being considered would make unplanned crossings almost impossible – and could spell the end for physical barriers like walls and fences

L

ike a nutshell, the rubber dinghy bobs through the endless blue of the Mediterranean. A tiny black dot in the glittering water that disappears then reappears in between the troughs and crests of the waves. The dinghy has been drifting for days, somewhere between Morocco and Spain, far from the boats and planes of the coastguard. Seemingly unnoticed, it sails towards Europe. But what none of the 38 refugees on board suspect: the dinghy has been under observation for some time. High up in space, a satellite has been tracking its every move...

HOW DO YOU MONITOR A 9,000 MILE BORDER?

Who makes it, who doesn't? The fate of thousands of refugees is decided on the Mediterranean Sea, off the coasts of Italy, Greece, France and Spain – and on the 23rd storey of a skyscraper in the Polish capital Warsaw. This is where the central command of the European border control agency Frontex is based. The EU-funded special unit has more than 300 employees. It runs dozens of patrol boats, helicopters and drones and has access to several satellites.

“If people want to come, they will. We can't shoot them.”

Michail Partzyszek, Frontex

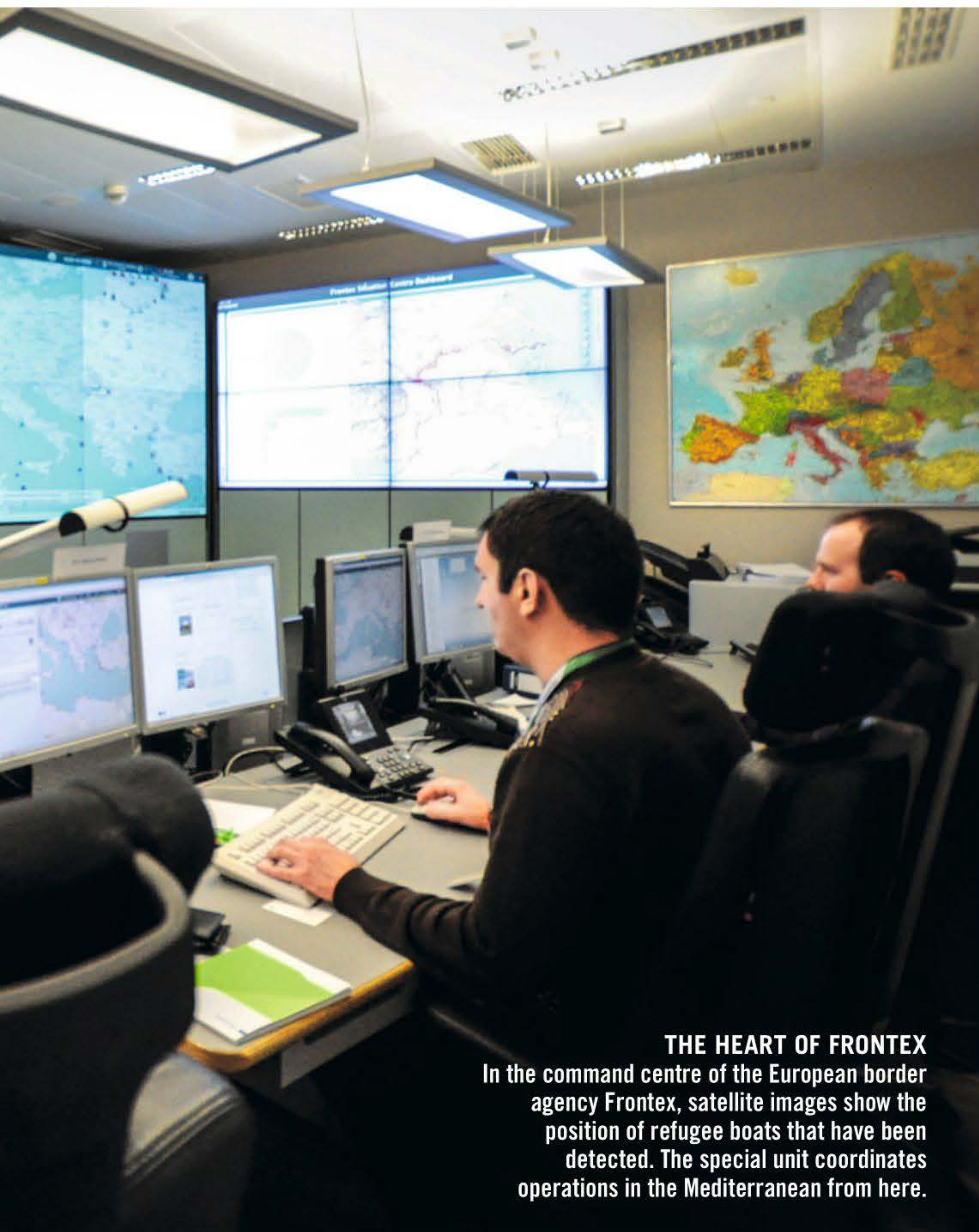


Frontex's surveillance area extends across nearly 9,000 miles of borders in Europe. The task so far: tracking down capsized vessels, saving people from drowning, seizing refugee boats and registering the occupants on shore. It's a mammoth undertaking, especially when you consider that an estimated 138,000 people travelled across the Mediterranean to Europe in the first ten weeks of this year alone. But how exactly should this task be managed in the future? And can high-tech surveillance make the border fences erected by the likes of Hungary redundant?

Frontex HQ is something of a

fortress. Four safety barriers, metal detectors and an iris scanner stand between the outside world and its 23rd floor nerve centre. Information gathered on the front line is fed back to the situation room here. Huge monitors on the walls show images from satellites and drones alongside maps of the Mediterranean. On one of the screens: scores of green dots, each one representing a ship or boat carrying refugees. Agents analyse the images and pass on the vessels' coordinates to the mobile deployment teams at the scene.

One of the satellite images shows a stretch of sea between Morocco and Spain with a lone green dot on it.



THE HEART OF FRONTEX
In the command centre of the European border agency Frontex, satellite images show the position of refugee boats that have been detected. The special unit coordinates operations in the Mediterranean from here.

Frontex notifies the Spanish coastguard who quickly despatch a ship and helicopter to the scene. A few hours later, 38 refugees – dehydrated but alive – are fished from the Mediterranean Sea and brought to the European mainland. Exhausted and hungry, if they can't prove their refugee status they face immediate deportation.

In spite of this, thousands of others have also made the journey across the Med this year in an effort to reach Europe. Some have drowned as a result of rough seas and leaky boats. In the future, Frontex wants to help make both scenarios significantly less regular

occurrences. But even the most conservative security experts no longer believe this is possible using just barbed wire fences and military ships. And so strategists in Brussels and Warsaw are currently undergoing something of a paradigm shift. Instead of building higher and higher walls, the EU is currently massively increasing surveillance measures with the help of Frontex. The satellite monitoring being used at the moment is just the tip of the iceberg. Its border control system, Eurosur, is currently being expanded. Eurosur is a vast system encompassing surveillance cameras, drones, thermal and



Project: AEROCEPTOR **WILL AUTONOMOUS HELICOPTERS** **SOON BE PATROLLING THE COASTS?**

These autonomous airborne drones are set to replace patrol boats, helicopters and border fences in the future. The EU has granted €5 million of funding to develop the first prototypes of these flying robots, which use electromagnetic shockwaves, quick-hardening polymer foam and pyrotechnics to stop and slow both boats and land-based vehicles. According to the official project overview, AEROCEPTOR will also be used to stop terrorists, drugs and weapons smugglers – as well as battle people traffickers. It's not yet been explained exactly how the technology will be deployed. The project's test phase ends in May this year.

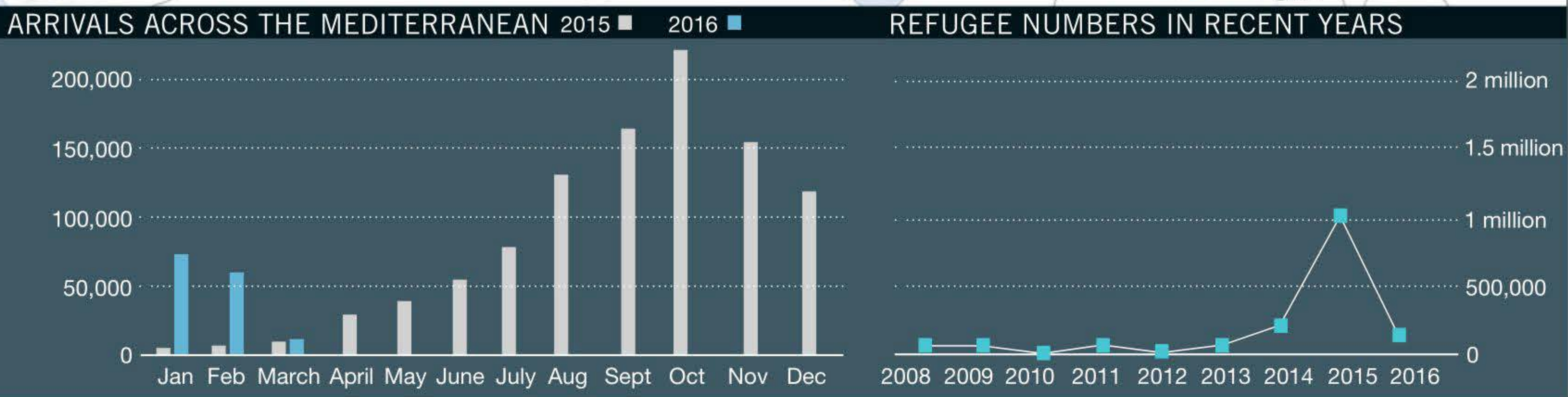


Project: TALOS **WILL COMBAT ROBOTS** **PATROL EUROPE'S BORDERS?**

Yet another prototype, this border protection robot is equipped with hi-tech surveillance technologies rather than weapons: radar, cameras, sensors and on-board computers are all part of the package. The robot is designed to patrol Europe's borders completely autonomously, scouring the area for illegal migrants, people traffickers or smuggling operations, and then raising the alarm so that they can be detained by border protection troops. The development of TALOS cost €20 million. It's unclear when – and if – it will go into production.

THE DEADLIEST BORDER IN THE WORLD

According to UN figures, around 150,000 refugees reached Europe by crossing the Mediterranean in the first ten weeks of 2016. Official figures show that 440 people died during the sea crossing. But experts fear that the real figure is far higher.



infrared sensors, robots and more. Add to this the most modern coastal radar and electronic sniffer dogs for “detecting hidden people”, and researchers are already building the border control systems of tomorrow.

The goal: in future, refugee boats should be detected shortly after setting sail in international waters. Under the framework of the cooperation treaty, partner countries like Libya, Morocco or Tunisia will be able to intercept the boats before they reach European waters. Another advantage of the high-tech surveillance: criminal gangs of traffickers can be caught in the act and arrested. In addition, Eurosur

will guarantee the systematic registering of all migrants and refugees, who would otherwise be able to travel unnoticed and unchecked through Europe, in reception centres on the Mediterranean coast. In reality there are already thousands of migrants in Europe who aren’t registered and therefore can’t be deported.

The importance of Eurosur to EU governments becomes even clearer when you look at what Frontex costs. The budget for running the border control agency has risen from €6 million in 2005 to €340 million last year. And so the main beneficiaries of the European

refugee crisis are predominantly defence contractors and technology firms. German magazine *Der Spiegel* claims that representatives from these two industries have been advising the EU Commission on the technical matters of border control for years. The result? Lucrative new contracts for their employers...

Putting to one side this seeming conflict of interest, the expansion of high-tech surveillance systems is now considered by experts to make much more sense than building higher and higher fences. Because it’s not just borders that can be saved by the detection of refugee boats – but human lives...

PHOTOS: PR. INFOGRAPHIC: PR

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THE DARK MACHINATIONS OF 'THE WATER CORPORATIONS'

HOW MANY LIVES

DOES THIS

BOTTLE COST?

Price for the

A thought experiment: imagine a corporation sets up headquarters in your city. Large warehouses and factories are built, a new workforce is recruited, and a fleet of blue trucks stands ready and waiting. Then holes are drilled into the ground. Deep holes – more than a hundred metres deep, reaching far into the soil. The workers are searching for something. But what? When all that dribbles out from your taps and showerheads is a brown, stinking brew, you realise what the corporation is digging for: water. After a short time the company makes the commodity available again. Packed in plastic bottles for

1,000 times its former price, the water can be bought in the supermarket – in fact, that is now the only place to obtain it. An absurd scenario? In the UK, water is still a public good and is not

“

“Water is life.
Depriving a human of these natural resources is nothing short of murder!”



Moulana Usman Baig
All India Imams Council

allowed to be entirely privatised – at least not yet. In many parts of the world, however, this scenario is far from unusual...

It is just after 6pm in Doornkloof: Lawrence picks up a freshly packaged water bottle and makes his way home from the Nestlé bottling factory. To get there, the factory worker has to walk through a long tunnel that runs beneath the motorway. Lorries thunder by overhead, each of them laden with the water that he has just bottled. Lawrence lives in a village on the other side of the tunnel – simple wooden huts, cabin toilets, mountains of rubbish. At home his children grab curiously at the half-litre bottle of water. Replenishments will arrive the following day. That's because,



VALUABLE GOODS
In Europe little thought would be given to a 0.5-litre bottle of water like this one. In countries like Nigeria, however, bottled water is vital for survival – but is more expensive than petrol.

Price in the supermarket: **70 pence**

rest of the world: **3.6 million deaths per year**

Wonderpedia on the **biggest crime** of the 21st century...

Earth's water

THE TOTAL VOLUME OF WATER ON EARTH IS

332.5M CUBIC MILES

97.5%
saltwater

2.5%
drinking water

70%
of that is held
in ice, clouds
and lakes

30%
is available in
groundwater

COUNTRIES THAT
CONSUME THE MOST
BOTTLED WATER

- 1 USA
- 2 Mexico
- 3 China

Sales of
bottled water

in millions
of litres



2007 2017
(estimated)

“

“Water required for drinking and basic hygiene is a human right: that’s **1.5%** of global water withdrawal. I am not of the opinion that the other **98.5%** is a human right.”

Peter Brabeck-Letmathe
Nestlé CEO



although the village is just a few hundred metres away from the plant where 282,000 litres of water is bottled every day, there is no public access to water for the families there. At least not since the Swiss food corporation Nestlé acquired the drinking water licence for the South African village.

In the Nestlé factory, however, fresh water is constantly flowing. Once bottled, it is branded as ‘Pure Life’. Lawrence and his colleagues work in the bottling factory for 12 hours a day – from six in the morning to six at night.

They are allowed just one 15-minute break a day. The Swiss firm recommends that everyone should drink at least two litres of water daily to stay healthy, and that includes their workers. But the employees are only given one litre of water a day, packaged in two 0.5-litre bottles. “When a company like Nestlé comes along and says, ‘Pure Life is the answer, we’re selling you your own ground water while nothing comes out of your faucets anymore or if it does it’s undrinkable’ – that’s more than irresponsible, that’s practically

a criminal act,” says Maude Barlow, former UN Senior Advisor on water. Seventy per cent of the Earth’s surface is covered in water, but 97.5% of that is undrinkable saltwater. Of the remaining 2.5% that is theoretically useable, two-thirds is locked in glaciers, clouds and ice, as well as in swamps and permafrost. This means that only a comparatively low volume of fresh water on Earth is drinkable – and it’s that which has caused the merciless war for the water that is raging in so many countries.

In the background an all-powerful water cartel is pulling the strings. This syndicate is composed of a so-called World Water Council, a powerful lobbyist group with 300 members drawn from the biggest corporations in the world. Also represented: economic institutions like the World Bank, which promotes the privatisation of all public goods. The influence of the World Water Council stretches to the highest political ranks of the industrialised nations. Its goal: privatising all of the freshwater on the planet.

Bottled water is the zenith of this privatisation process. Mineral water companies – as Nestlé have done in South Africa – build huge bottling plants on lakes, rivers and aquifers, pumping the ground dry. The consequences: massive amounts of carbon dioxide are released into the atmosphere and billions of tons of plastic waste are generated. And the industry leader in the bottled water business is the Swiss firm Nestlé.

“Nestlé is a predator, a water hunter. They are looking for the last pure water in the world,” says Barlow. And Nestlé is just one of

many players in the \$800 billion water industry: the Coca-Cola Co., PepsiCo Inc. and SABMiller plc are also battling to gain control of every water source on the planet. In their quest these giant corporations purchase the water licences for large areas – valid for several decades. Then they pump out the clean groundwater, add minerals, stick it in plastic bottles and sell it at 1,000 times its original

value. In Nigeria, for example, a litre of Pure Life is more expensive than a litre of petrol. It is invariably the countries in which water is already a scarce resource that suffer from the excessive water exploitation. The consequences: in many places the groundwater level is sinking so much that whole towns are losing their natural water reserves. If you can't afford the exorbitantly priced bottled water,

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“In the driest continent on the planet, the only way for the price to go is up. **Those who can afford to pay for the water will have the luxury.**”



Kellie Tranter
Lawyer and activist

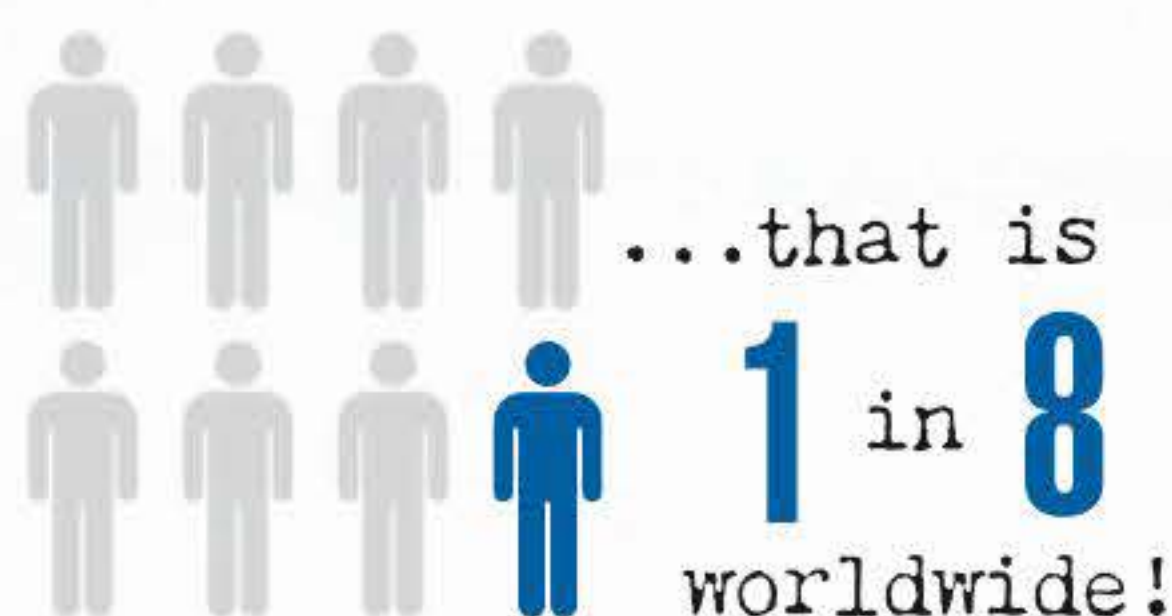
Drinking water — a human right or not?

On 28th July 2010, access to clean water was recognised as a basic human right by the General Assembly of the United Nations. In spite of that more than 3.5

million people die every year because they only have access to dirty drinking water. Often their wells, which provide cleaner water, are drained dry by the food industry.

783 MILLION

people have no access to safe drinking water



3.5 MILLION

people die every year as a result of contaminated water

In the year **2026**
water will be scarce in
two-thirds of the world



then your only option is to drink from the same rivers that are used by the corporations for dumping their rubbish. Illnesses that cause diarrhoea like cholera, typhus and other infectious diseases are part of daily life – just like death: worldwide this water politics kills seven people per minute. That equates to 3.6 million people per year. More children die as a result of drinking contaminated water than from malaria, HIV, traffic accidents and all wars combined.

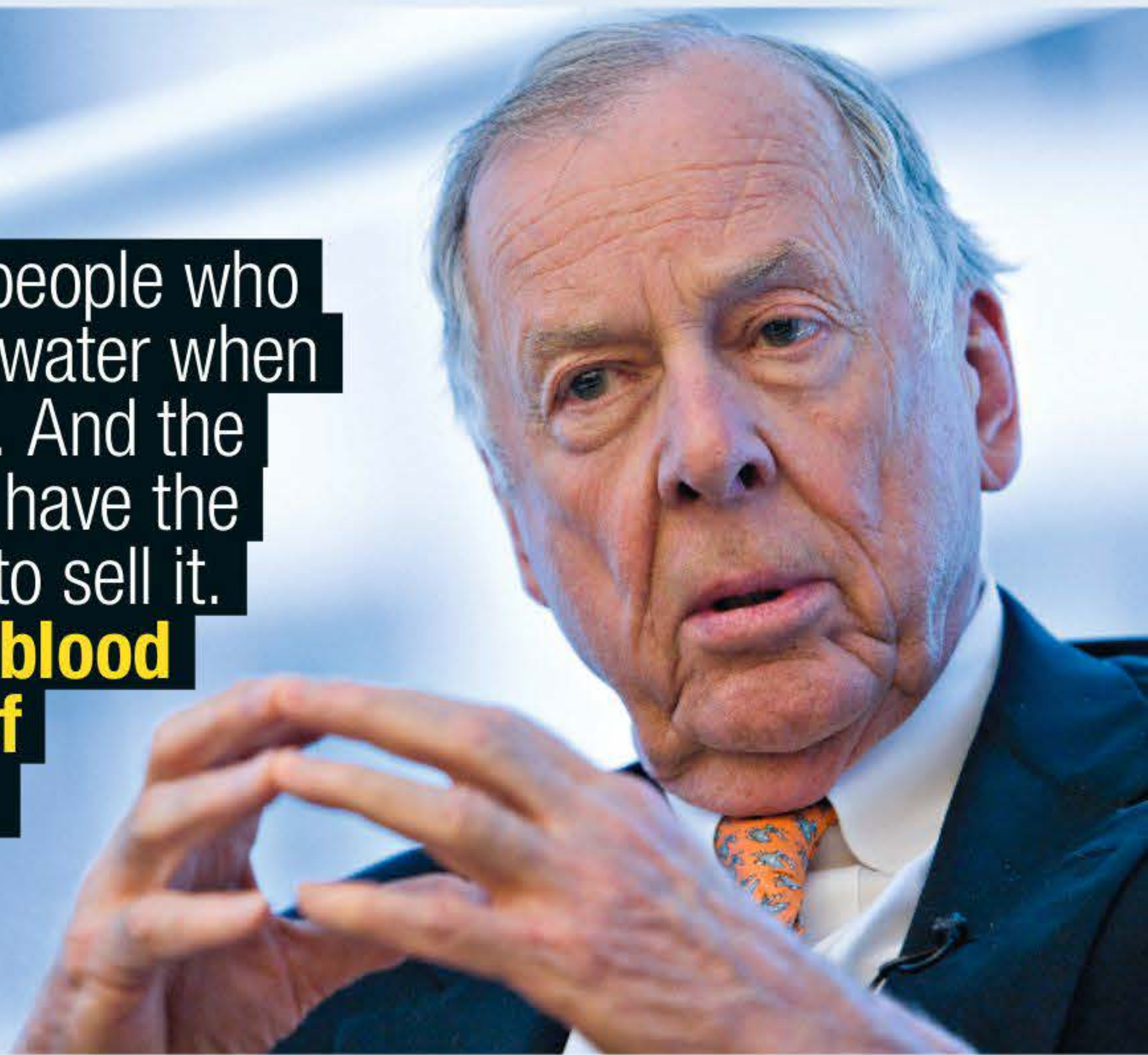
The scope of the consequences for the privatisation of water was shown as early as the year 2000. At that time Bolivia's president Hugo Banzer was forced to privatise the country's water supply by the International Monetary Fund and the World Bank. The fallout for the population: water prices shot up by 300%, meaning on average a quarter of their income went on water bills alone. The city of Cochabamba's 600,000 residents were forbidden from building wells. They weren't even allowed to collect rainwater. A band of multinational corporations headquartered in the US had their hands ready and waiting on the taps. For four months, civil unrest raged: people engaged in open

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“There are people who will buy the water when they need it. And the people who have the water want to sell it.

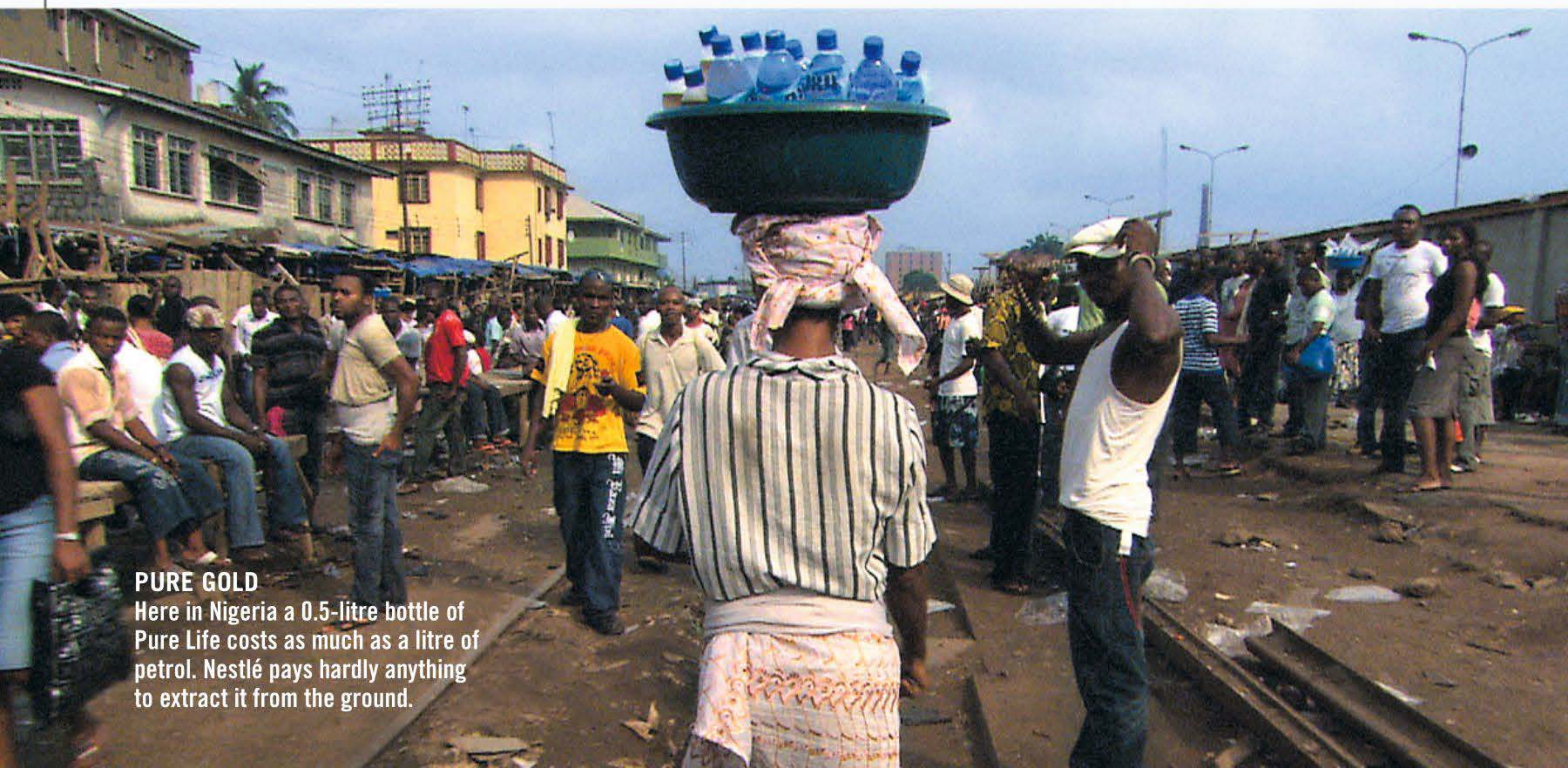
That's the blood and guts of the thing.”

T. Boone Pickens
Water speculator
and billionaire



street brawls with the police and demonstrated en masse against the inequality. In April 2000, the violence escalated. Deaths and injuries led to the government imposing martial law on the city. Eventually, the country's leaders caved in to the pressure from the population and changed their minds about the privatisation. The corporations may have lost this particular water war – but in hundreds of other countries, they have already won.

Take Mexico. While the drilling of new wells around the capital Mexico City is forbidden due to chronic water shortages in the area, Nestlé is allowed to extract groundwater there and sell it packaged in bottles. The impact of this is particularly devastating in poorer countries because there are few alternatives to expensive bottled water. But the practice happens in richer nations like Canada and the USA, too. When almost all the water sources in



PURE GOLD

Here in Nigeria a 0.5-litre bottle of Pure Life costs as much as a litre of petrol. Nestlé pays hardly anything to extract it from the ground.



“It’s scandalous that a company like Nestlé can take hundreds of millions of litres of water at basically pennies at the same time as residents are being asked to conserve water.”



Liz McDowell
Campaigner and
water rights activist

Atlanta dried up during the 2007 drought, the Coca Cola Co. continued to pump water out of its deeper wells – and sold the local population their own groundwater at many times the price of tap water. It was something the former vice-president of PepsiCo, Robert S. Morrison, probably sympathised with. “The biggest enemy is tap water,” he said in 2000.

In Europe and in North America clean drinking water spouts from the taps – practically for free. And so the water industry invented the biggest marketing trick of all time: they turned a basic nutrient into a lifestyle product. Bottled water is advertised as being healthier, tastier and appropriate for the modern age – but tap water is just as clean and healthy, and also undergoes rigorous testing. Yet the marketing has been extraordinarily successful: today, 50,000 bottles of water are sold every minute in

>

How much water do I need?

Each UK resident uses about 150 litres of water per day: for drinking, cleaning, showering and flushing the loo. But this figure is misleading because the production of food, clothes and other goods also requires water. The residents of Dubai use the most water in the world – an astounding 500 litres per resident per day. The USA comes in second at 300 litres per person.



2 litres

In reality, each human being requires just two litres of drinking water every day...

5,000 litres

...but the production of a day's food requires a staggering 5,000 litres of water.



1 KILO OF RICE

1 PAIR OF SHOES

1 PAIR OF JEANS

1 KILO OF BEEF

1 CAR

3,000 litres

8,000 litres

9,800 litres

15,415 litres

30,000 litres

US supermarkets. That's 80 million bottles a day. If you were to line up all the 0.5-litre bottles sold in a week, they would wrap around the globe five times.

It's not only the source of the water that's problematic, but the packaging too: to manufacture the plastic bottles used to supply a years' worth of bottled water in the USA alone, 2.7 billion litres of crude oil is required. The plastic packaging also contains toxic BPAs and phthalates, which have been linked to hormone disruption.

An even greater problem is the impact all this has on the environment. America has a poor record when it comes to recycling: four out of every five bottles end up in the tip, where they are usually buried or burnt. Some, however, end up in rivers or the sea. Five huge garbage patches have already formed in the world's oceans – mainly comprising small shredded pieces of plastic, a story covered in the very first issue of *Wonderpedia*.

Samples taken from the oceans show more microscopic plastic particles in the water than plankton – in 1999 the ratio of plastic to plankton

“The water wars will not be fought on the battlefield by opposing armies, but on the trading floor by commodity traders.”



Anthony Turton
Water expert

was a sizeable 6:1, but by 2008 it had rocketed. Researchers found that for every kilo of plankton, there was 46kg of plastic. These micro-particles are consumed by small fish which, in turn, are eaten by bigger fish – and these eventually end up on our plates.

The value water holds today is reflected in the stock market. Someone investing in water equity funds in 2000 would have seen their holding increase its value by 75% in the space of three years. Population growth will ensure that demand exceeds supply. It's reckoned that by 2030 more than 40% of countries in Asia and southern Africa will experience

a serious shortage of drinking water. Experts like Maude Barlow are certain of one thing: this shortage will lead to the biggest refugee crisis in history. “The water crisis comes along, and rather than face this, these governments and their corporate friends and their political leaders are all saying, ‘Don't worry, it's just a temporary issue,’” says Barlow. “If they really understood the water crisis, they would have to admit that we can't keep going on the way we're going on.”

And since water is also important for the processing industry, other corporations are now competing for a share of the market. In August 2012, for example, Australia sold the largest irrigation property in the southern hemisphere, the Cubbie Station, to Chinese and Japanese investors for AUS \$232 million. The sale gives the investors rights to huge reserves of water, which will likely flow into the Chinese textile industry. “I see fleets of water tankers and storage facilities that will dwarf those we currently have for oil and natural gas,” says economist Willem Buiter.

What about in Europe, where water is still a public good? Could the scenario described at the start of this article happen here? Well, the EU is currently negotiating the Transatlantic Trade and Investment Partnership (TTIP) with the US. A controversial free trade deal, it's all about reducing the regulatory barriers to trade for big business, so corporations will be able to bid for water concession companies, for example. John Hilary, the executive director of War on Want, a group that opposes TTIP, has issued a resounding warning: “Instead of water being a human right, it would be treated as a commodity and people could be cut off if they can't afford it.” That would likely be Nestlé et al's dream come true...



Why you should be wary of buying mineral water

There are hundreds of brands of mineral water available to buy in the UK – and all of them are perfectly safe to drink. But if you want to protect the environment and the people at the source when you buy, it's best to follow these guidelines. 1. The water should come from a local source: the further it has been transported, the higher the carbon footprint. Fiji Water, for example, transports its bottles thousands of miles, while Belu Water comes from Cambridge and Shropshire. 2. Reusable bottles are better than one-use bottles. Glass is less damaging to the environment than plastic as it is easier to recycle, say packaging experts. 3. Drink tap water where possible.



[SMARTER IN 60 SECONDS]

4 FASCINATING QUESTIONS ABOUT WATER

Is the human body **made of water**?



Between 60% and 70% of an adult human body is water, depending on the individual. But specific organs vary – the heart and brain are roughly 73% water while the lungs clock in at a staggering 83%. Even our bones, which seem so solid, are 31% water. The element enables our body to transport the materials we need to live, such as vital proteins and nutrients, throughout the body as well as carrying waste products out of our systems. Fun fact: a human foetus is 95% water for the first few months of its existence.



How do **astronauts** on board the International Space Station get water?



It might sound repulsive, but it's necessary: transporting materials to space is so expensive that astronauts on board the ISS must drink their own bodily fluids. The water is purified before it's consumed: on-board systems collect every last drop of moisture from the astronauts' breath, sweat and urine before using iodine to disinfect the water. For emergencies, 2,500 litres of water is kept in reserve on the station.



Where is the **driest place on Earth**?





Parts of Chile's Atacama Desert are so dry they haven't seen rain since records began. This arid desert on Chile's coast is often touted as the driest place on Earth thanks to its position in a rain shadow, which means moisture is ferried away over the Andes mountains. Despite the harsh conditions, more than one million people reside on the fringes of the Atacama Desert, mostly crammed into the region's coastal cities, harvesting fog to convert into drinking water and to grow crops with.

Where is the tap water laced with **lead**?



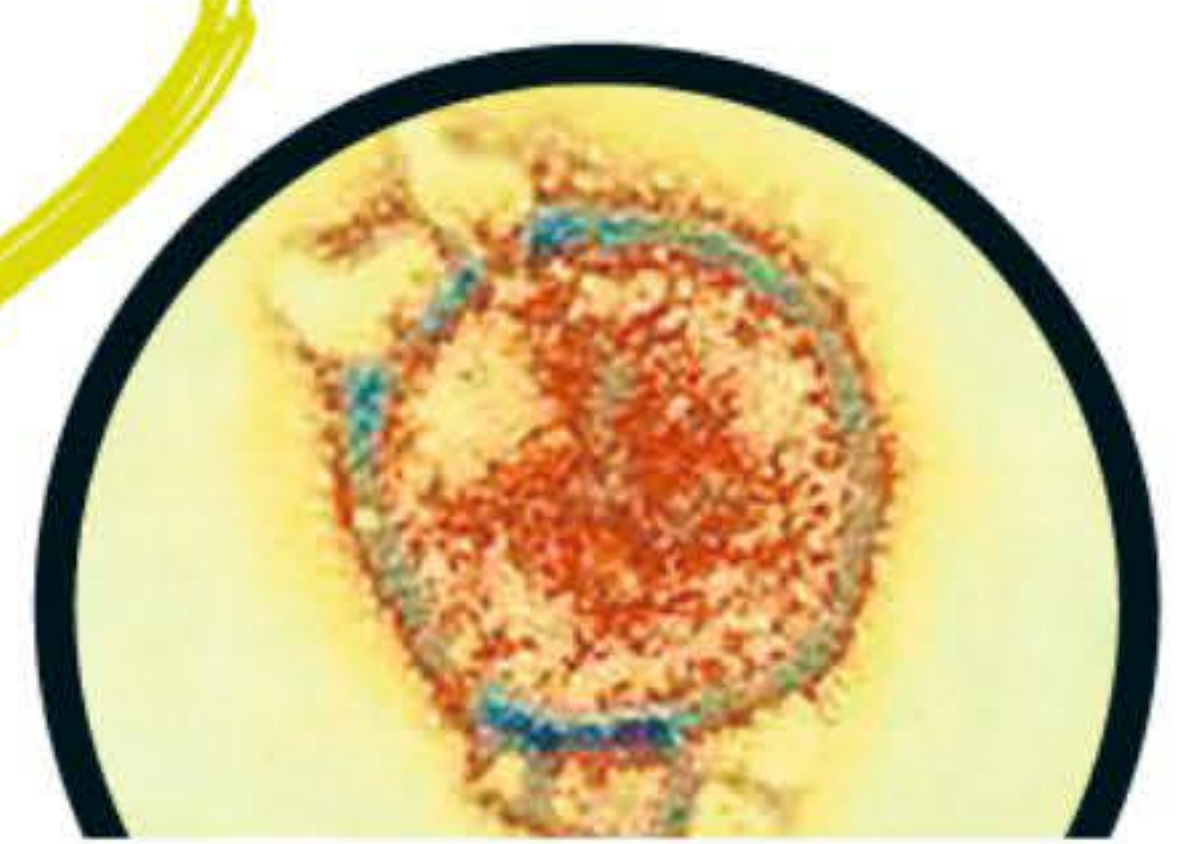
In 2014, residents of Flint, Michigan, began to complain about the taste, smell and colour of the water flowing from their taps. Tests revealed that the city's drinking water was highly corrosive as well as being contaminated with dangerously high levels of lead. The heavy metal has been linked to brain damage, miscarriages and mental health issues. Flint's crisis developed when city authorities switched the municipal water supply source from freshwater Lake Huron to the Flint River, a notoriously dirty waterway used for decades as a dumping ground for industrial waste. Their rationale? Saving money. Although this water was sanitised before being pumped into homes, it reacted with the lead in the city's antiquated metal pipes and leached into the public water supply. State health officials now say that every child under the age of six in Flint should be considered lead-exposed. What's more: there's no time frame for replacing the city's pipes. Residents are forced to rely on bottled water handed out by officials for bathing, drinking and cooking.



Fruit bats carry more deadly viruses than all of those stored in the world's high security laboratories put together. But why do other animals and humans die when the hosts themselves remain healthy? Could the key to fighting deadly diseases be found in their genes?

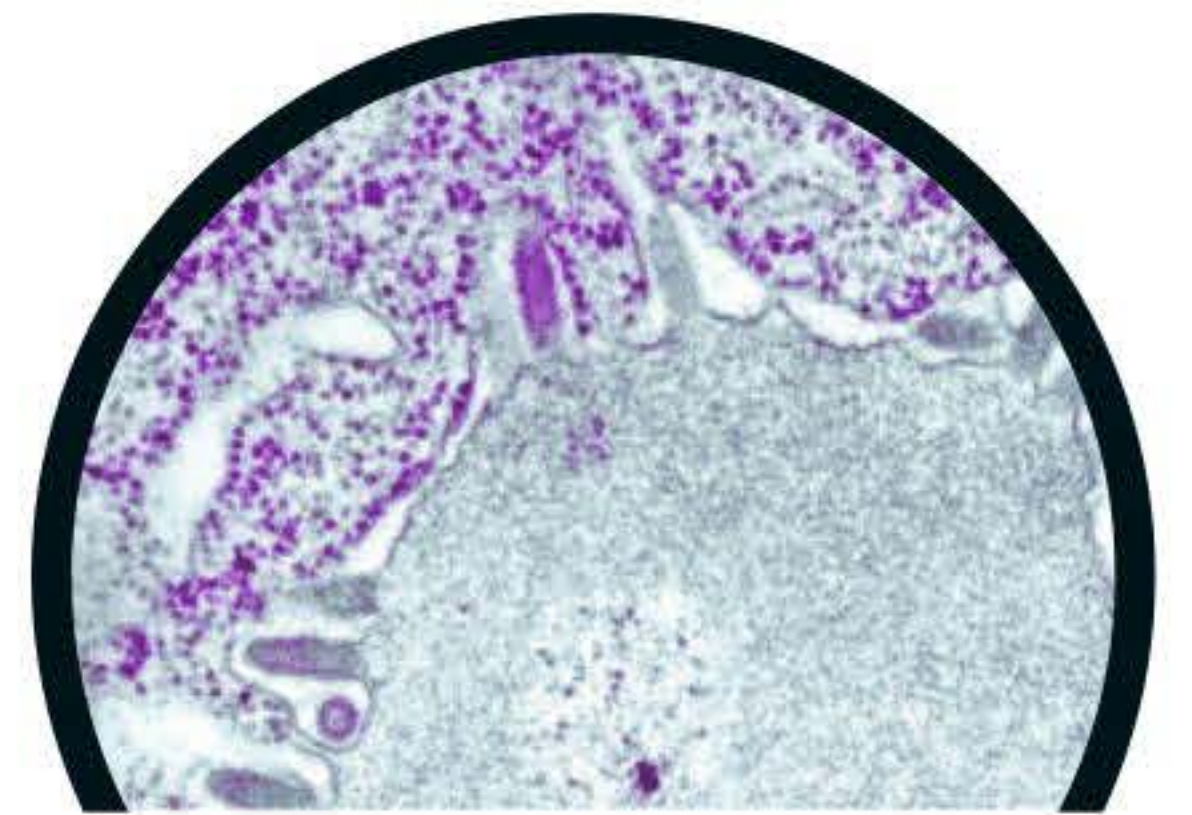
THE FLYING VIRUS LABORA

DEADLY CARGO



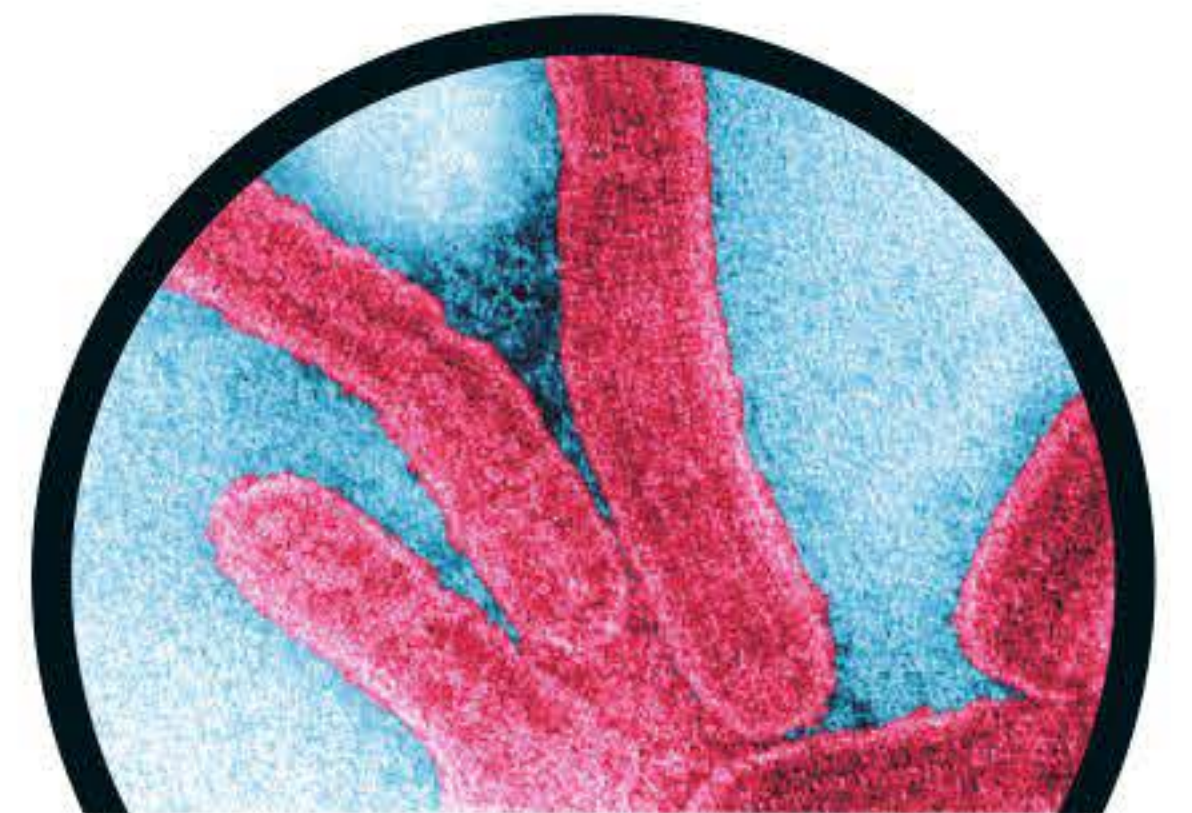
HENIPAVIRUS

This family of two related viruses, the Hendra and Nipah virus, proves fatal in up to 70% of cases.



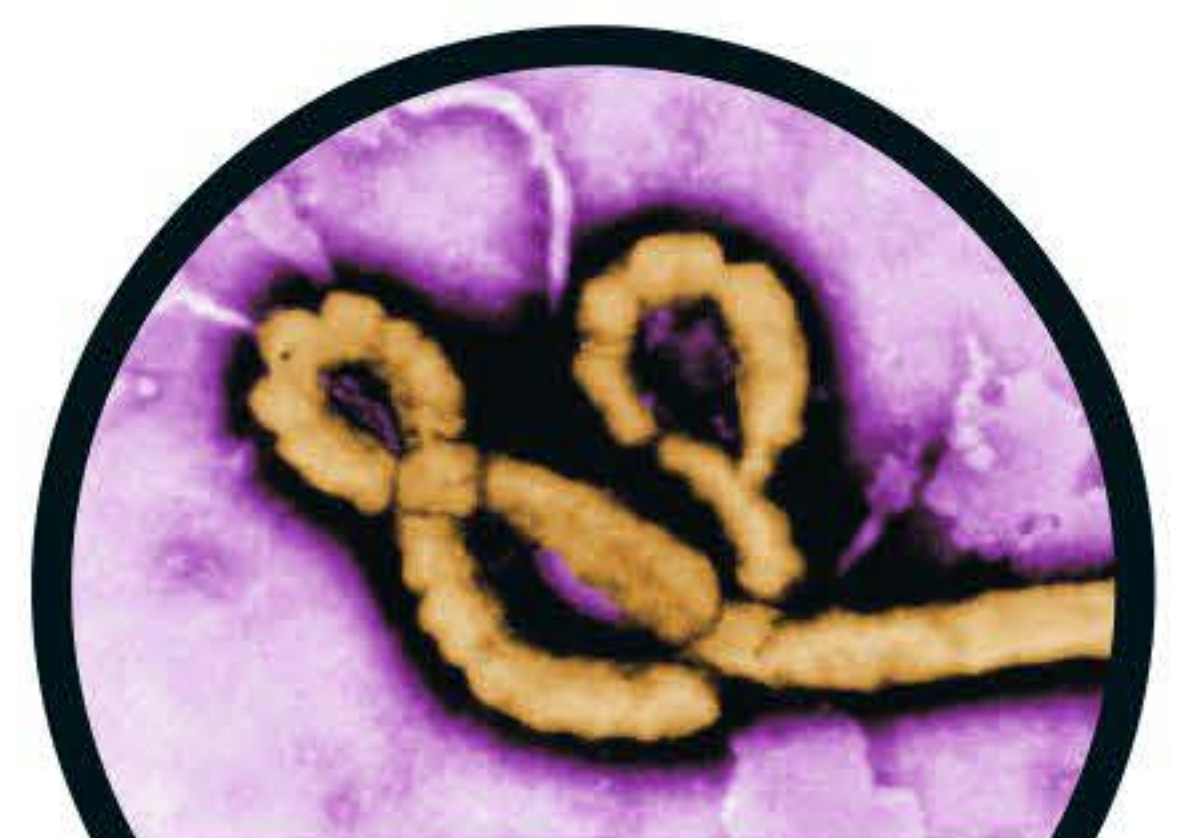
LAGOS BAT VIRUS

Around a third of bats carry this pathogen, which can trigger rabies in humans.



MARBURG VIRUS

This causes fever in humans and can lead to internal bleeding and death within days.



EBOLA VIRUS

This pathogen has devastating effects: it is highly contagious and no cure currently exists.

TORY

The stumble seemed so inconsequential that Sonja Metesch* will only it remember several weeks later. During a tour of a cave in the middle of the Ugandan rainforest, the 40-year-old Dutch woman loses her footing and injures her hand supporting herself on some rocks. Just a scratch, she thinks, as she rejoins the group. It's a mistake that will prove fatal...

HOW DO YOU GET INFECTED WITHOUT REALISING?

Back in the Netherlands, Metesch develops a raging fever. Then things spiral out of control – fast. She is rushed to hospital suffering from multiple organ failure and, just days later, dies. Metesch has fallen victim to the Marburg virus, a disease transmitted by wild animals – even though she never came into direct contact with one. How could that have happened? The virus must have entered her body when she cut her hand on the rocks.

The open wound must have come into contact with some faeces in the bat-infested cave. Fruit bat faeces to be precise. Droppings from a species that carries more viruses inside its body than all of those stored in the world's high security laboratories...

So do fruit bats really pose such a risk to humans or was the Dutch woman's case an extremely unlucky one-off? Humans have been afraid of bats for centuries. In recent times, this fear has soared as scientists have proved that the animals carry viruses that cause deadly epidemics like Ebola – even though it is very rare for them to transmit the virus directly to humans. "It only happens if you are bitten or eat the meat of an infected fruit bat," explains Tony Schountz from Colorado State University. Or – as in Metesch's case – when an open wound comes into contact with the animal's saliva, blood or excrement. Which begs the question: if fruit bats carry deadly pathogens like the Ebola and Marburg viruses, why do they never fall ill themselves? Researchers have now discovered that while other animals and people die from these viruses, fruit bats won't suffer so much as a fever. On the contrary,

their lifespan is ten times that of other similar-sized mammals and they almost never develop cancer.

So does the key to healing also lie inside the fruit bats' deadly cargo? Researchers are convinced it does and are now trying to uncover the secret of the fruit bat immune system. They hope that we may soon be able to thank fruit bats for improving our health – and even our life expectancies.

HOW DO YOU LIVE WITH A DEADLY ENEMY IN YOUR BODY?

For that to become a reality, scientists first need to understand how fruit bats can live seemingly healthy lives unharmed by the pathogens lurking in their cells. The virologist Linfa Wang from Duke-NUS Medical School in Singapore has researched just that. He spent almost two decades in Australia studying fruit bats and how they transmit the deadly Hendra virus to horses. Wang discovered that, unlike other mammals, the fruit bats could control the virus. They displayed neither a fever nor a raised level of white blood cells in their blood. But how did their immune systems somehow render the virus harmless?

Scientists believe the answer lies in the animals' fast metabolism. To help them fly, fruit bats require up to 20% more calories than a non-flying mammal. This speedy metabolism raises the level of free radicals in their blood, which have the potential to damage their DNA. To prevent this from happening, a bat's immune system is constantly in overdrive. It cleans up the dangerous molecules – including potentially deadly viruses. Since their immune system functions so well, the animals don't get sick. The virus multiplies in their bodies and they pass it onto their offspring – but they never develop symptoms. ➤



TOP SECURITY

These researchers are testing fruit bats for the Ebola virus. The animals are eaten in Africa and were the likely cause of the epidemic.

Contrary to popular perception, **few viruses kill humans. Humans actually kill themselves, because of excessive inflammation.**

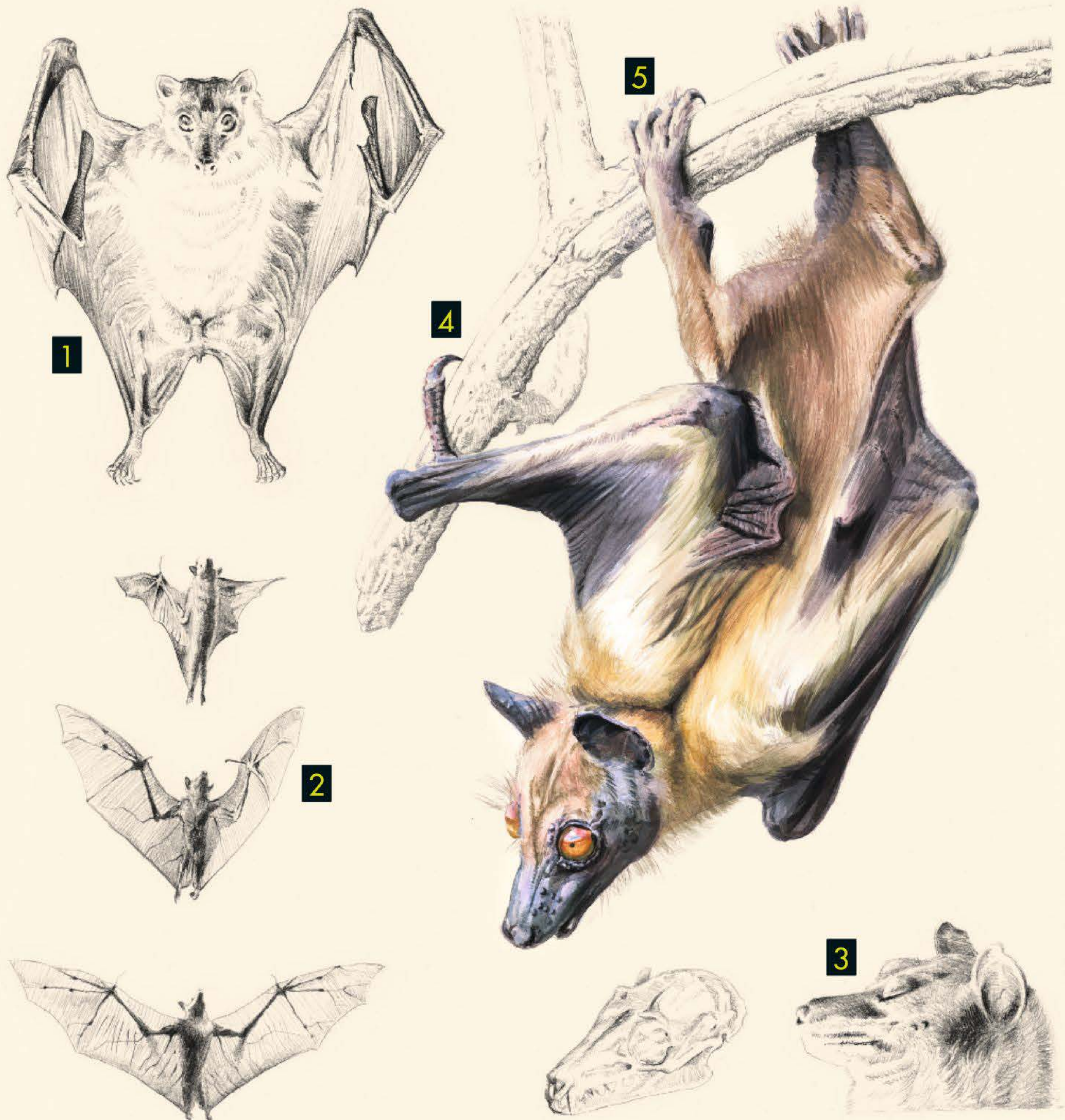
**LINFA WANG, VIROLOGIST
DUKE-NUS MEDICAL SCHOOL**

*NAME HAS BEEN CHANGED

THE ANATOMY OF FRUIT BATS

Like all bats, fruit bats belong to the *Chiroptera* order. After rodents, these are the most diverse species of mammals in existence. They can weigh up to one kilo and have a maximum wingspan of 1.7 metres. Unlike other

types of bats, most fruit bats do not navigate using echolocation. Instead, they have outstanding vision and an excellent sense of smell. Their diet consists mainly of fruit, flowers, pollen, nectar and insects.



The African straw-coloured fruit bat shown here has a maximum head-to-toe length of just 20 centimetres (1) and a maximum wingspan of 75 centimetres (2). It has a dog-like head and a good sense of smell with which to sniff out ripe fruits. (3). The bat also

feeds on nectar, and thus plays an important role in the pollination of plants – 40% of trees in the world's rainforests would be unable to produce fruit without their help. Its favourite food sources are the *Borassus* and date palm trees. Thanks to the strong, hooked claw on its

thumbs (4) the bat is a good climber and can defend itself against attackers. It can use its feet (5) like hands to open the shells or skins of fruits. The bat bites into hard shells with its sharp canines and mashes the fruit between its teeth, sucking out the nectar.



WHAT MAKES THE ENEMY TICK?

Canadian researchers in protective suits experiment with the Ebola virus in a high security laboratory.

Fruit bats live up to **ten times longer** than other similar-sized mammals – and they almost **never** get cancer.

EMMA TEELING,
ZOOLOGIST,
UNIVERSITY OF DUBLIN

Unfortunately, however, this is by no means the case for humans. In the event of a similar viral invasion, our immune system would react by exhibiting an extremely powerful inflammatory response. Wang explains: “Contrary to popular perception, few viruses kill humans. Humans actually kill themselves because of the excessive

inflammation.” In other words, unlike fruit bats, which have a constantly activated immune firewall, our operating system ends in a short circuit – and it collapses.

“IT’S ONLY A MATTER OF TIME UNTIL WE WILL BE ABLE TO UNLOCK THIS SECRET”

Scientists are now trying to identify the proteins that fruit bats use to control inflammation and prevent tumours forming. These proteins – or modifications thereof – could then be used to treat conditions characterised by life-limiting inflammation such as arthritis, rheumatism and heart disease. The findings could also contribute to a cure for deadly viruses like SARS and Ebola. Many human lives could be saved. Zoologist Emma Teeling from the University of Dublin is convinced: “It’s only a matter of

time until we will be able to unlock this secret once and for all. Mother Nature has the answer.”

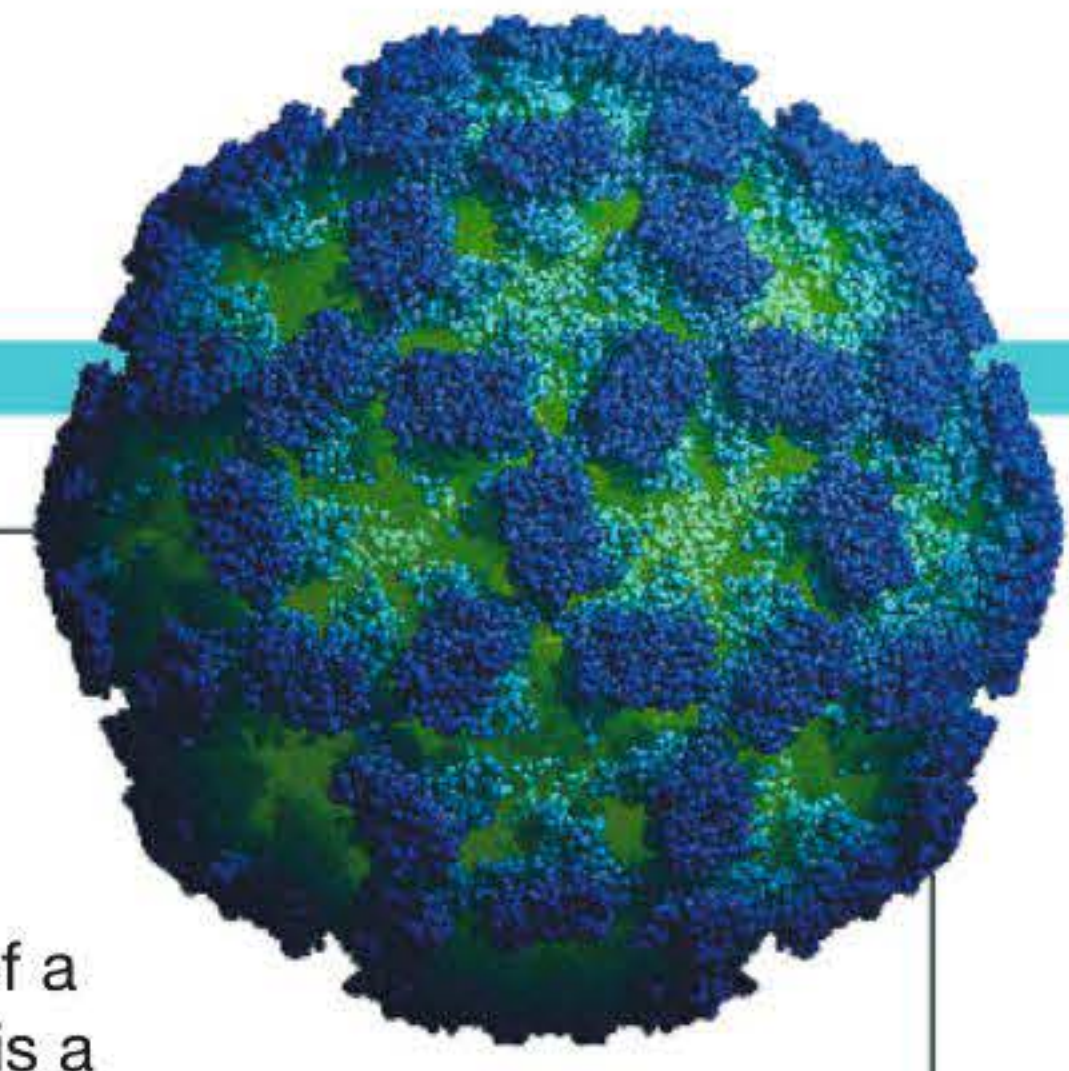
Eradicating fruit bats for fear of contagion could have catastrophic consequences, says Wang. Studies have shown that culling populations can actually increase the risk of an epidemic – moving or destroying colonies increases stress levels in the bats, which raises their viral load and the risk of spillover. The contamination of vast areas from injured and dead bats also raises the risk of the virus spreading. This in turn raises the risk of other animals being infected.

Moreover, bats are crucial to the planet’s ecological balance because they eat insects that damage crops. In fact, a colony of bats can end a pest outbreak in a single night, not thanks to the viruses they carry but simply by deploying their excellent hunting instinct.

[SMARTER IN 60 SECONDS]

4 FASCINATING QUESTIONS

ABOUT VIRUSES



How long can a virus survive without a host?



Most viruses can only remain active for a few hours outside of a host, but the norovirus (above) is a survivor – the vomiting bug has been found on a carpet after 12 days. The virus can also withstand extreme climates, existing happily in a temperature range of minus 20 to plus 60 degrees Celsius. Added to that, the norovirus is also extremely mutable, as well as highly adaptable. Every two to three years a new strain develops, making it impossible for researchers to develop a vaccine against the pathogen.

Can **viruses** cure cancer?



Scientists at Duke University in North Carolina have found a way to use the polio virus as a weapon against glioblastoma, the most common and most aggressive form of brain cancer. To do so, they genetically modified the virus so that it could only multiply in tumour cells, not in healthy tissue. The virus created as a result, known as PVS-RIPO, is injected directly into the tumour (area shaded red, above). The virus then fights the cancer in two ways: it directly destroys the tumour cells and stimulates the immune system to find and attack the infected cancer cells. The therapy was first tested on humans in 2011 and has already achieved promising results.

Do viruses keep the sea healthy?



Scientists have recently discovered that viruses act as the ocean's immune system. Every day they kill bacteria and algae so that the ocean's balance is not disturbed. "If there were no viruses, the world's oceans would clog up. Bacteria and algae would grow and grow and by the end you'd have an ocean full of sludge," explains marine biologist Willie Wilson from the Bigelow Laboratory for Ocean Sciences in Maine. Viruses also regulate biodiversity (luminescent plankton, below). When a population grows too large, it becomes susceptible to infections.



Which is the **world's most aggressive virus?**



In 1967 African green monkeys were imported from Uganda to Germany – and the Marburg virus came with them. It is one of the most aggressive viruses in the world: the human fatality rate can be up to 80% in some outbreaks. No vaccine or effective remedy exists. The first victims were scientists in Marburg, Germany, who were carrying out research on the monkeys in the laboratory – hence the name. Alongside the Ebola and Lassa viruses, the killer is still being researched in a high-security laboratory at the Institute for Virology at the University of Marburg.



10,000 PARTS IN 32 DAYS

The D-Check or Heavy Maintenance Visit (HMV) sees technicians stripping down an entire aeroplane. It takes about a month to complete, during which time some 10,000 parts are checked. Most planes can expect to undergo four or five D-Checks over the course of their lifetime.

HOW SAFE IS MY HOLIDAY FLIGHT?

Lightning strikes, extreme temperatures and engine failures: for a passenger plane to be able to withstand all that, every five years it has to spend a month at the world's biggest MOT centre. *Wonderpedia* watched one being put through its paces...





HOW CAN A CORNER CAUSE A PLANE TO CRASH?

Doors, windows, fuel cap: anything subject to in-flight stresses is curved in shape to counter the effects of pressure. At an altitude of 10,000 metres the air pressure outside the aircraft is lower than the pressure inside the passenger cabin. With these differing pressures exerted on the plane, the circumference of the cabin expands by a few millimetres, like a hot air balloon when it is in the sky. If the windows were square, dangerous levels of stress could build up on their corners and lead to cracking. Basically, where there's a corner, there's a weak spot, which is why aerospace engineers pay particular attention to even the smallest parts on the fuselage. Meanwhile, passengers are protected from outside temperatures of minus 50°C by a special insulation layer visible in the picture on the left.

The last rays of daylight flicker through one of the biggest garage doors on Earth. Behind this portal – more than 200 metres long and fully glazed from top to bottom – sit three wide-body aircraft, among them a Boeing 747, for more than four decades the largest passenger plane in the world.

Parked in Bay 10 is an Airbus A330. The ten-and-a-half-year-old passenger plane has exactly 50,795 flying hours under its wings – equivalent to it spending 5.8 years in the sky. Over a

similar period a car manages about 4,000 driving hours – after which, in spite of regular MOTs and services, it might be ready for the scrapyard. This Airbus, however, only has between a third and a half of its expected useful life behind it. But

Why is a car ready for the junkyard after ten years, while an aeroplane can fly for 25 years and longer?



INSPECTION VISIT
Lufthansa technician Marc Ladewig (right) explains how his team checks around 10,000 individual parts over the course of just 32 days.

can a passenger plane really remain safe and airworthy for such a long period of time?

“No other mode of transport is serviced so regularly,” explains Marc Ladewig from Lufthansa Technology, the world’s largest aeroplane maintenance outfit. His company carries out 1,700 checks a day and enjoys a 10% market share of this lucrative market. “A basic check is

performed before every flight, a more thorough service takes place roughly every two months and a detailed inspection lasting days or even weeks happens every other year,” he goes on. “But the crowning glory is the D-Check, a complete overhaul

that takes place every five years: we spend 35,000 manhours checking and repairing more than 10,000 parts over 32 days. Afterwards the plane is like new again. Or even better than new, because we always incorporate the latest technology.” ➤



BACKBONE

Inlaid floor panels cover one of the most important structures in the plane: the seat tracks. Not only do they hold the passenger seats in place, they work with the cross struts to keep the entire fuselage stable.



VASCULAR SYSTEM

To connect the cockpit to the systems in the rear, huge cables almost 50 metres long are needed. Put together, the air vents, hydraulic cables and electrical wires in the ceiling panels measure several miles in length.

CABIN SKELETON

Each economy-class row in the 5.28m-wide cabin seats eight passengers in a 2-4-2 configuration. But here only the overhead luggage bins remain. The galley and toilets are normally found in the foreground of the image and are two of the areas most likely to need repairs due to moisture damage.



1



2



3

STRIPPING

Three coats of paint weighing 200-300kg cover the exterior of the plane. During a large-scale service this needs to be removed so that the condition of the fuselage can be examined.

2

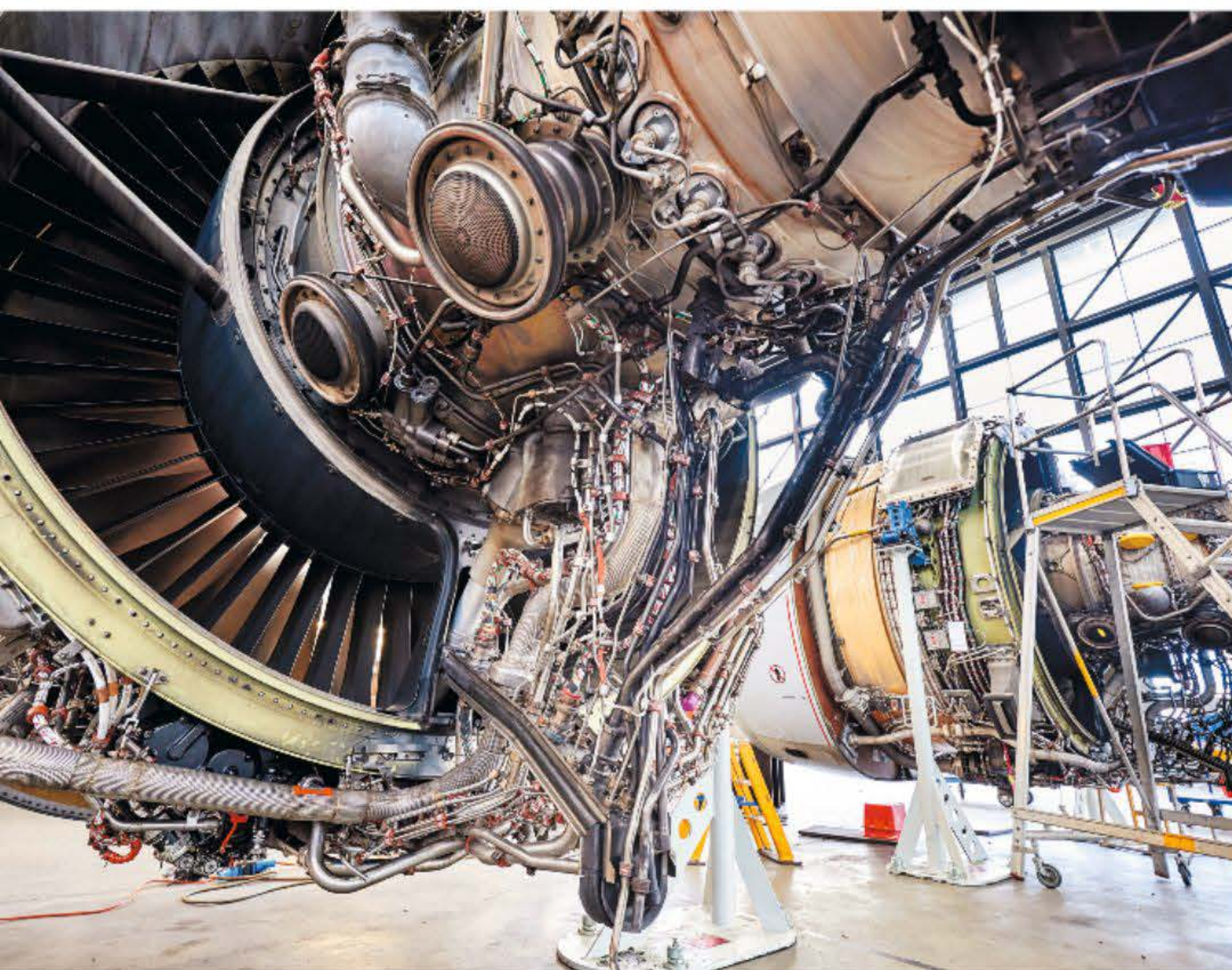
CHECKING

After the wing-fuselage junction, the undercarriage is the part of the plane most subject to stress. The bolts in the middle need to withstand 150 tons during every landing. On average, a medium-haul aircraft taxis around 8,000 miles a year from terminal to runway (and vice versa).

3

MARKING

Every defect – even a tear in a seat – is marked with a red (structure), orange (electrics) or yellow (mechanical) sticker. All markings are checked by two separate engineers, following the ‘four-eyes principle’.



Ladewig and his colleagues work on the 60-metre wingspan Airbus around the clock. Depending on the work required, the cost of its D-Check will run to seven figures but any delays or overruns could result in a six-figure penalty. The MOT appointment, therefore, must be seamlessly accommodated in the works schedule. The plane with a list price of £157 million delivers the last passengers and their luggage to Hamburg in the evening and then makes its way to the garage where it is parked and scaffolded.

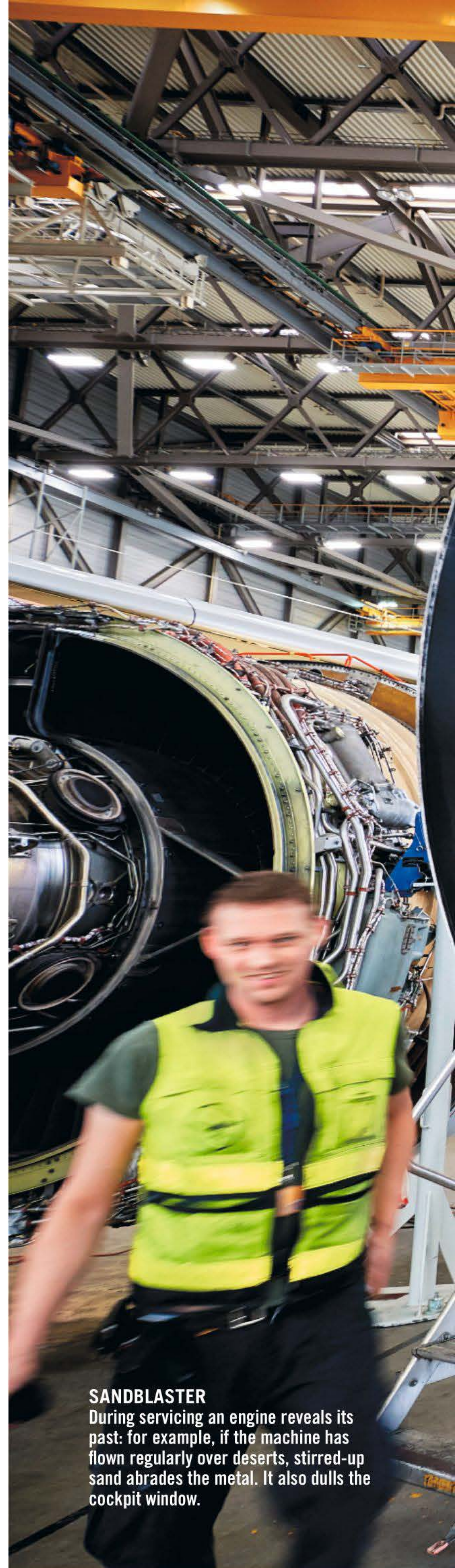
Today, on day ten of the check, several miles of cables wind their way through the skeleton of the fuselage. Some cable harnesses contain hundreds of individually numbered wires. Every flight-relevant system, such as those controlling the direction of flight, must be independently checked three times. "There are hundreds of computers in the server room under the cockpit, which all control the same flight systems," explains Ladewig. "Because of this they're not allowed to come from the same manufacturer in case any software

POWER UNIT
Each engine sucks in around 800 cubic metres of air per second (equivalent to the volume of a large detached house). This helps generate the enormous forward thrust.

updates prove to be faulty. These could compromise the systems and put the plane in danger." The engineers even clamber into the emptied tanks on the wings to inspect the wiring there.

In around 23 days time the Airbus will be put through its final inspection. Engineers will spend ten hours testing all operating and back-up systems. This is followed by a three-hour control flight in which two pilots and two engineers act out critical situations like a stall or an engine failure and observe whether the emergency systems react. Only once these are completed can the aircraft receive its stamp and be discharged. "In theory a plane maintained in this way can fly forever," explains test engineer Stefan Hansen. "But at some point the repairs become too expensive. And the new, optimised models simply fly more efficiently."

How do you test a plane crash?



SANDBLASTER
During servicing an engine reveals its past: for example, if the machine has flown regularly over deserts, stirred-up sand abrades the metal. It also dulls the cockpit window.

EXHAUST

A plane is not a rocket: while the latter is propelled as a result of blowback during gas combustion, the giant rotors (left image) in an aeroplane engine generate thrust that powers the plane forward. The round opening here serves as a discharge point for exhaust gases, and less for propulsion. Once a month the entire engine must be internally flushed.

ENDURANCE ATHLETE

Using a mini-camera, engineers also examine the interior of the 14 rotors in the engine. Despite temperatures of $1,200^{\circ}\text{C}$ in the combustion chamber, and compressor blades rotating at close to the speed of sound, the engine manages 20,000 flying hours until it needs its first overhaul. That's equivalent to 2.3 years of continuous operation.

[QUESTIONS & ANSWERS]

HOSTILE CONDITIONS

The atmosphere on Mars is 95.3% carbon dioxide. Oxygen only exists in the parts-per-thousand range. Temperatures of up to minus 133 degrees Celsius are normal.

DEADLY RADIATION

As Mars lacks a magnetic field, astronauts would be exposed to carcinogenic space radiation. Protective shields made with four-metre thick Martian rock could protect the ground station from constant exposure to the cosmic particles.

HOW DO YOU CONSTRUCT A BUILDING ON MARS?



■ A manned Mars mission is NASA's next big project, but researchers are not only concerned with when and how mankind will get there but also how they might survive on the inhospitable red planet.

The main obstacle facing the mission? In order to build a settlement there, several tons' worth of building material from Earth would need to be shipped to the red planet – an expensive undertaking when you consider that the transport costs of a spaceflight to Mars are in the \$3 billion per ton range.

Scientists from Northwestern University in Illinois have now

found a more cost-effective solution: they have succeeded in producing a type of concrete using raw materials available on Mars in large quantities.

To create the material, sulphur was heated to 240 degrees Celsius so that it became liquid, then mixed with simulated Mars soil made from silicon dioxide and aluminium dioxide. The sulphur hardens during cooling and binds with these particles. Another advantage of this Mars concrete is that it can be melted down again and recycled – and it's also twice as stable as the normal concrete used on Earth.

HOW DO YOU CATCH A DRONE?

With more autonomous unmanned vehicles being released into the air every year, the risk of collisions is increasing – recently, a BA flight from Geneva was hit by a suspected drone during its descent to Heathrow. Now there is a growing fear that drones could be used by terrorists to mount airborne attacks, and work is taking place on how best to defend against the threat. Airbus is developing jamming technology, Boeing is researching

lasers, while one company has turned to nature's own predators. On behalf of the Dutch police, the firm Guard From Above is training eagles to take out drones mid-flight. One video shows a drone hovering in the air before an eagle swoops down, grabs it with its talons and flies off with it. Training the birds takes a year and, so far, all tests have been successful. The force will decide soon whether to employ the eagles in the war on terror.

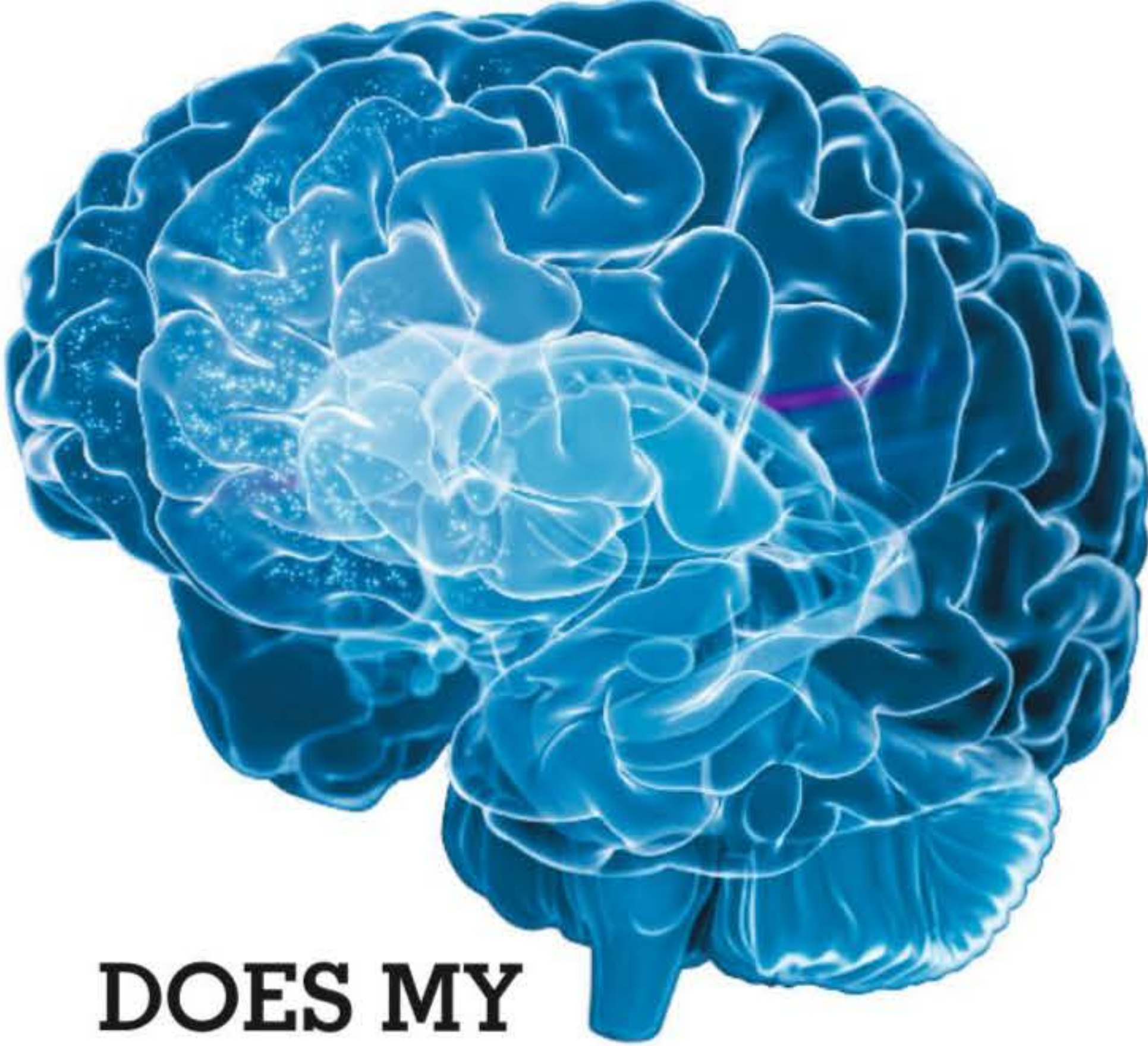
×
93mph

is the speed a bald eagle can reach through the air.

The metre-long bird of prey can transport bounty weighing up to 15kg.



The greatest danger to the eagle comes from the drone's fast-moving rotor blades. Thankfully, the bird's talons are protected by thick keratin scales.



DOES MY BRAIN HAVE SEASONS?

Winter blues, seasonal affective disorder, spring exhaustion – the seasons certainly influence our moods. But now Belgian researchers have found that our brain itself experiences seasonal shifts. As part of a study, participants had to solve tasks over the course of a year during which time their brain activity was measured. The results showed areas connected to concentration were most active in June and least active in December. The working memory does considerably less in autumn than in springtime. Depending on the season, therefore, the brain must operate at different strengths to achieve the same level of performance.



Can my mobile phone hunt an earthquake?

Smartphones deliver important information – but could they soon save our lives? US researchers from the University of Berkeley have developed the app MyShake, which uses an algorithm to filter vibrations that occur during an earthquake and measures them with the help of sensors in the phone. The data and GPS information is then sent to the university's seismology department. The app is already able to recognise earthquakes of 5.0 on the Richter scale and at a distance of up to six miles. Once the test phase has finished, the app should be made available to both Android and iOS users.

HOW QUICKLY DOES A SHIP BREAK IN TWO?

On 14th April 1912 the Titanic collided with an iceberg and sank in the Atlantic. 1,514 people lost their lives. Now, 104 years later, researchers have generated a minute-by-minute reconstruction of the disaster.



While still on the water's surface, the Titanic breaks in two. The front part of the ship sinks vertically into the depths, but the stern only spirals towards the seafloor some minutes later. It ends up 600 metres away from the bow.

11.40pm The Titanic hits an iceberg at a speed of 24mph.

1.50am The flooded bow sinks while the ship tilts towards the port side.

2.15am The increase in water pressure causes the front funnel to break off. More water floods through the additional opening.

2.18am The build-up of pressure between the bow and the stern is so strong that the hull snaps in two.

2.19am The stern also tilts downwards and water floods the broken front side.

2.20am The stern turns so it's in a vertical position and then slowly spirals downwards.

2.21am The front mast breaks away, the funnels break off. The stern rotates and sinks with the bow.

While the stern and bow sink towards the floor, more debris breaks away.

At 35mph the bow crashes onto the seabed (left). The stern shatters on impact (right).

WHY DOES THIS JEEP COST \$250,000?

It has seen action in both Iraq and Afghanistan, but now, 30 years after its introduction, the US Army has retired its fleet of iconic Humvees. The military vehicle will be replaced by the Oshkosh Joint Light Tactical Vehicle (right), a 300 out on top after proving to be faster JLTV is clad in a landmines, meaning US Army plans to \$250,000. The JLTV

PROTECTIVE SHELL
External armour is designed to offer similar levels of protection as a lightweight tank. It should be able to withstand landmines and artillery fire.

WORKLOAD
Fully laden with equipment and a four-man crew, the JLTV weighs in at around 8.1 tons. Its range is around 300 miles at a top speed of 69mph.

WEAPONRY

A missile launcher and machine gun mount are also part of the jeep's equipment.



How much wind can a tree withstand?

One of the many things that Leonardo da Vinci turned his hand to during his life was studying trees, in particular their resistance to breakage. Today, over 500 years later, French researchers have discovered the critical speed above which trees planted in urban areas are likely to either uproot or suffer broken branches. They found that a windspeed of 42 metres per second (94mph) is enough to damage over half of those trees not planted in a wood or forest – be they a slender birch or a gnarly old oak. Height, circumference, variety of tree and soil type play hardly any role.



10 STRANGE BRITISH LAWS

1

Eating chocolate on the Tube

was once illegal thanks to a peculiar 19th century English bylaw. Even more strangely, the edict applied solely to women riding on the London Underground.

2

Wearing socks within 100 metres

of a monarch was made illegal by Elizabeth I, who also banned shirts with “outrageous double ruffs” being worn at the Royal Court. James I later repealed the law.

3

Being drunk on licensed premises

is forbidden by the Licensing Act of 1872 – in other words, you can’t be inebriated at the pub. Luckily for modern-day revellers, this rule is rarely enforced.

4

Queue-jumping in ticket lines

is illegal if instructed to join a ticket queue by an authorised staff member, according to the Transport for London Railway Bylaws.

5

Writing a critical reference

in the UK is technically illegal due to our libel laws, unless the negative comments can be proven. For this reason, many firms will simply refuse to comment on a bad employee rather than risk ending up in court.

6

Feeling sickly? Don’t hail a cab

According to the Public Health Act of 1985, it is illegal for a person with the plague to knowingly travel in a taxi or to try to ride on a bus.

7

Handling a salmon

in ‘suspicious circumstances’ was made illegal by the 1986 Salmon Act. Though what exactly constitutes such a situation remains unclear...

8

Beating a carpet rug outdoors

is still an offence in any street in the Metropolitan Police District. But don’t fret, early-rising neat freaks – the law says you can shake out a doormat before 8am.

9

Housing more than one lunatic

at a time was barred by the now-obsolete Madhouses Act of 1774, unless you had obtained a specific licence allowing you to do so.

10

Gambling in a library

is forbidden by the Libraries Offences Act of 1898, as is remaining on the premises after closing time.

How close can lightning strike before it gets dangerous?

Even if you’re not in the immediate vicinity of a lightning strike, you can still be struck – indirectly. A bolt of lightning will be distributed in all directions when it hits the ground, so the actual danger zone extends to a radius of at least ten metres from the point of entry. If you are ever caught unawares during a thunderstorm, you should crouch as close to the ground as possible while keeping your legs together. Otherwise a lethal step voltage could travel between them and may, in the worst case scenario, cause a cardiac arrest.

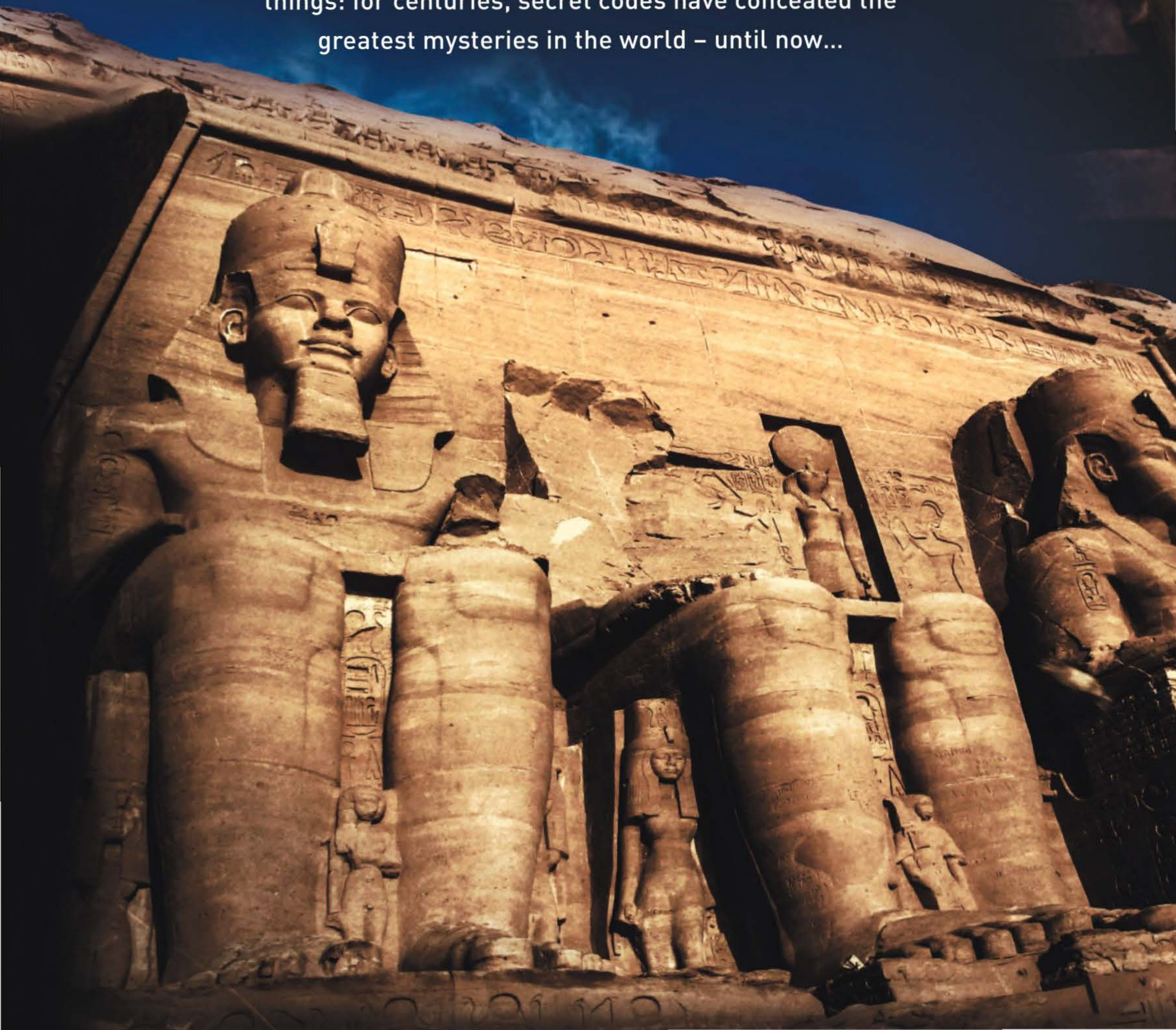


WHY DO CATS HATE WATER?

Cats avoid water because they can’t swim, right? Wrong! The real reason felines tend to shun the wet stuff is because their fur quickly becomes sodden and loses its insulation properties as a consequence. The result: their body temperature drops, they become less agile and also run the risk of drowning. A kitty’s fur has other important functions, too. It acts as a sensory organ, even helping a cat to navigate in the dark along with its whiskers. It’s also an important part of their identity because it carries a cat’s own individual body odour. If the fur becomes wet, the cat has to release the odour through its saliva and secretions from glands on the side of its head and on its front paws.

THE GREAT PUZZLES OF WORLD HISTORY

They cause wars, topple governments and hide extraordinary things: for centuries, secret codes have concealed the greatest mysteries in the world – until now...





What did the PHARAOHS know about the realm of the dead?

The moment the priest has been dreading has arrived. He has carried out this procedure dozens of times – but never on a pharaoh. The priest follows one of the oldest and most meticulous codes in history: the mummification of a god king. The priest cannot afford to make any mistakes. Carefully, he inserts a hook into one of the dead man's nostrils. Using this, he'll mash the pharaoh's brain to a pulp. Sounds grisly, but it serves a purpose: it will enable him to pull the

brain out of the nose – all while ensuring that the face remains intact. If the face was damaged, the ancient Egyptians believed, then the pharaoh wouldn't be recognised by the judges of the dead – possibly denying him a rebirth. That, rather than death itself, was their greatest fear. This made the priests the most powerful caste and turned their secret code for eternal life into a holy relic: the *Book Of The Dead*.

According to Egyptian wisdom, a person had two souls, both of which escaped the body after death. The aim was then to retrieve them through religious rituals. But an incorrectly performed action, such as an improperly disembowelled body or a disfigured face, could jeopardise the rebirth.

Dying away from home was also a major source of worry. In 30 BC Cleopatra eluded capture and execution in Rome, choosing instead to commit suicide in Alexandria to ensure that the correct rituals of mummification were performed.

Without these rites, the journey through the underworld would be fraught with danger, according to the *Book Of The Dead*. The most important moment came when the deceased was faced with the

"I am yesterday,
today and
tomorrow."

BOOK OF THE DEAD,
Chapter 64

Eye of Truth before Osiris, the god of the dead, and his 42 judges. The deceased's heart was placed on a pair of scales, and if

it was found to be lighter than the Feather of Truth they were declared free of sin and could continue on to the afterlife. If the heart didn't betray its owner at this critical moment, the deceased then used the scarab from their grave. Magical formulae from the *Book Of The Dead* were engraved on the trinket, covering not only the journey through the underworld, but also spells with which to ward off danger. Magic was seen as the only useful weapon against the monsters of the underworld.

For centuries, researchers have been trying to unlock the secrets of the *Book Of The Dead*. But there are still passages that raise questions – in the search for the Egyptians' vast knowledge of the afterlife.

Did the Vatican control Europe with the aid of a secret CIPHER DISK?

When the first Crusaders returned to Europe from the

Holy Land at the end of the 11th century, they brought something dangerous with them: not a foreign disease or weapons, but a mathematical formula – one which triggered wars, toppled rulers and shook the power structures of the continent.

Frequency analysis, which was used as an aid to breaking classical ciphers, could be used to decipher all of the codes known at the time. This meant that coded letters – which passed through the hands of dozens of messengers, coachmen and sailors in the Middle Ages – were suddenly no longer as safe as they once were. No one could tell who had read their letter before it was delivered. This was a disaster for Europe's ruling elite – there was no alternative but to carry on sending messages between kings and popes. Necessity is the mother of invention and what the ruling classes desperately needed was a new system of encryption.

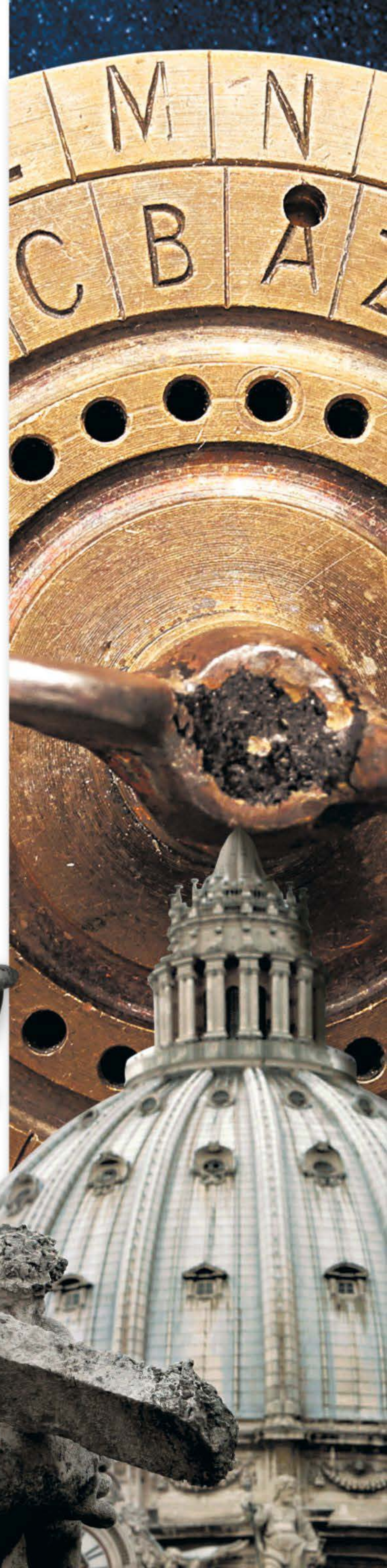
In this climate, the scholar Leon Battista Alberti was commissioned to invent an encryption method for the papacy. He quickly came up with a revolutionary cipher

disk comprising two rotating dials, a polyalphabetic codebreaker that was well ahead of its time. The disk shows which letter will be replaced with another (in the right-hand image, N equates to A, O to Z and so on.) The user gets a new code simply by adjusting the disks. For the system to work, the recipient needed an identical cipher disk – and instructions on how to set it. This could be specified verbally in advance, or announced by the first character of the coded correspondence.

For centuries, this disk was considered unbreakable – and gave the Vatican a huge strategic advantage. Using the protection afforded by this encryption method, popes influenced politics in Europe, claimed land and cities, put kings under pressure and dispatched powerful enemies – altering Europe forever.



IN WITH THE NEW
With the cipher disk, the Vatican established a new era of communication. Before its introduction, sealed letters could easily be opened or even faked.



Can an encrypted **FORMULA** reveal how a serial killer thinks?

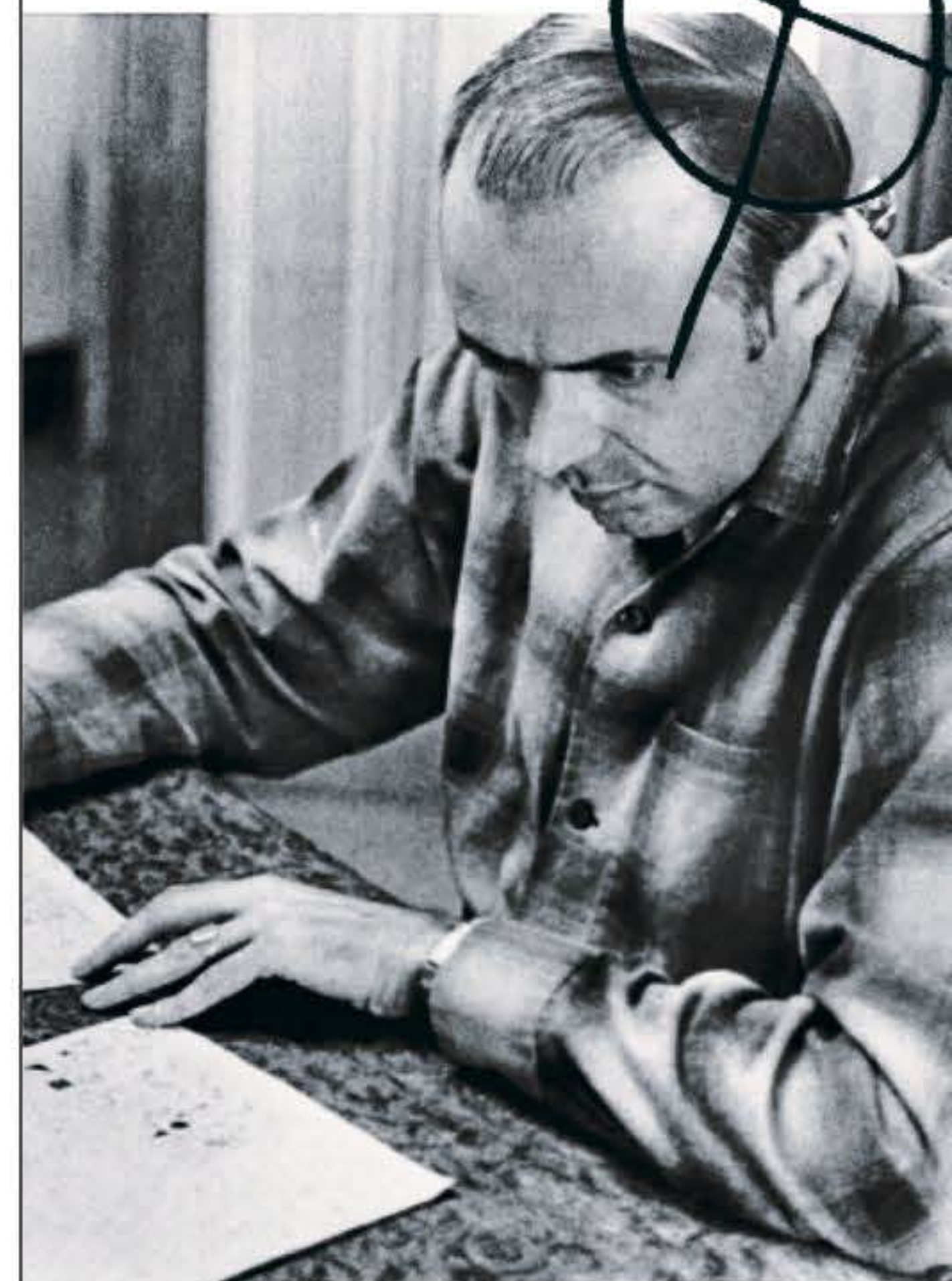
It is 20th December 1968: in a car park north of San Francisco, an anonymous gunman shoots two teenagers dead. They are the first victims in a mysterious series of at least five murders and two attempted murders that have never been solved – despite the perpetrator writing dozens of letters to the local press.

The killer used his own encryption system that consisted of at least 65 code characters. Among them were the 12 star signs of the classical Zodiac – also the name the killer gave himself. The encryption system was so hard to crack that the FBI revealed the ciphers to the public – in the hope that an amateur cryptographer might be able to solve the puzzle.

Married couple Bettye and Donald Harden rose to the challenge and managed to succeed where the CIA had failed: they decoded a 408-character cryptogram sent by the Zodiac Killer in July 1969. They suspected the criminal had a very narcissistic world view – and concluded that his note began with the words “I like”. This gave them the keys to unlock the code: “I like to kill people because it’s so much fun. It is more fun than killing wild game in the forest because man is the most dangerous animal of all. To kill gives me the

most thrilling experience.”

Unfortunately, the cracking of the first Zodiac code did not lead to the breakthrough that had been hoped for. The message revealed how the serial killer thought – but there was no evidence pointing to his identity. The Zodiac Killer has never been caught – despite revealing his name. One of his coded messages begins with the words “my name is...”, but the following words have never been decrypted, despite years of investigation by the best cryptographers. Over five decades, police have investigated and cleared thousands of suspects and the tips keep coming in.



AMATEUR CRYPTOGRAPHER
History teacher Donald Harden and his wife Bettye managed to decipher one of the killer's notes.

Does a secret **CHAIN OF PYRAMIDS** connect the first civilisations?

It's one of the most amazing unexplained phenomena in the world: a chain of pyramids circles the globe, almost exactly between 20 and 40 degrees latitude north. Built by the ancient Egyptians and Mayans, the constructions are famous the world over. And there are also half a dozen other civilisations that built pyramids, too. But how did this happen? Historians have long assumed that the cultures around the globe never came into contact with one another – they had no means to. So what's the

answer to this mysterious, ancient riddle?

In 1970, the archaeologist Thor Heyerdahl stated his belief that ancient Egyptians could have sailed across the Atlantic to the Canary Islands, or even Mexico, in handmade papyrus boats. There they could have exchanged cultures – and building tips – with the Mayans.

Still, concrete evidence that this journey took place has never been found. Could the Egyptians have discovered America 1,500 years before Columbus? That's not as crazy as it might sound –



ANCIENT NETWORK
Were the pharaohs in contact with the Mayans in South America? It's not just pyramid building that suggests this: South American produce has also been found in Ancient Egyptian tombs.

historians now know that the Vikings visited America long before Columbus. But what if the Egyptians' architectural prowess travelled via a different route?

The most important discovery of the ancient Egyptian architects was that no other shape of stone building could be built as high as a pyramid. You only need a basic knowledge of structural engineering and construction techniques to understand that a square of the same height would collapse.

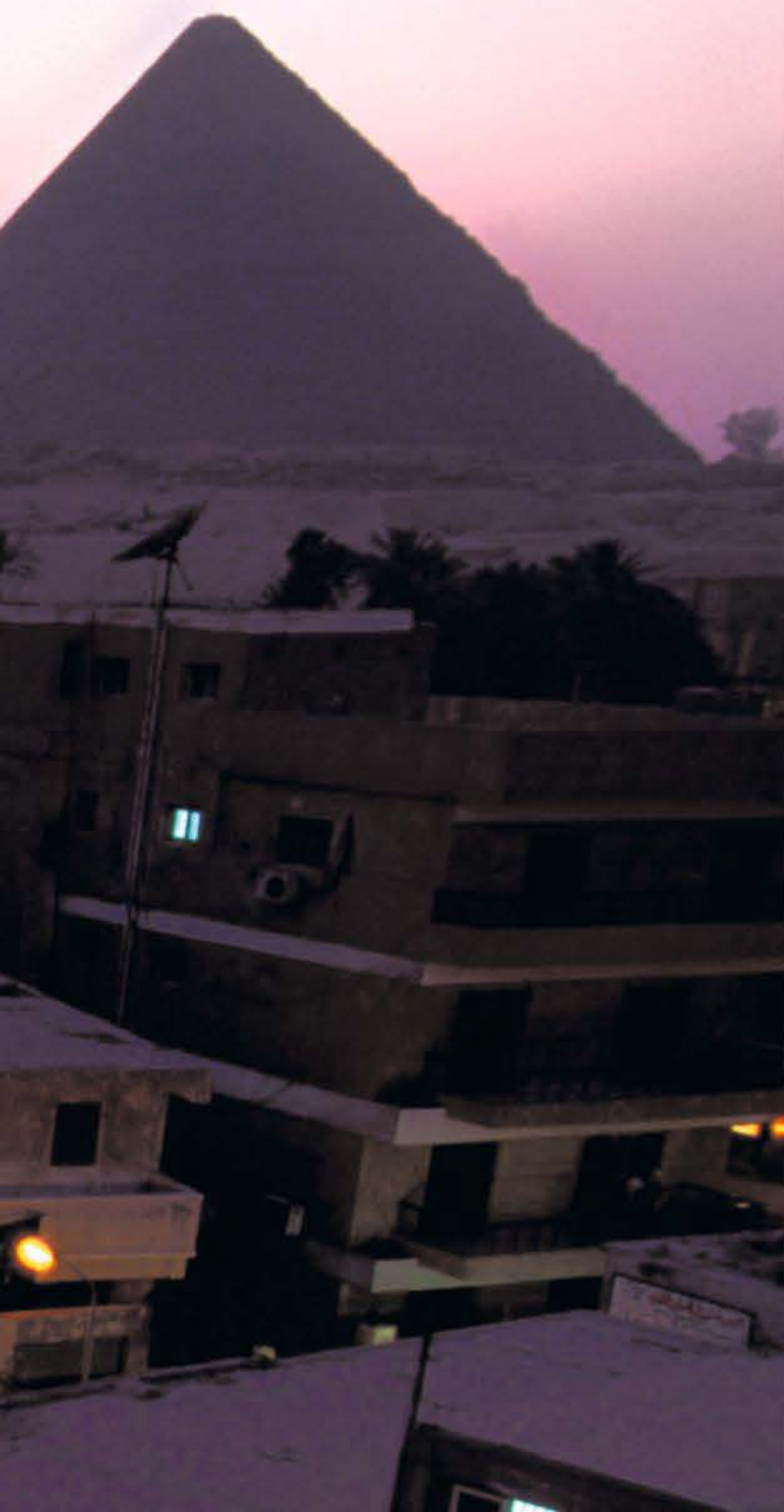
Cultural historians believe that this information travelled around the globe, almost like Chinese whispers. It was carried by artisans, architects, sailors and merchants – constantly being passed on from one person to the next. This is how a global transfer



Where was a secret **WORLD GOVERNMENT** founded?

system for knowledge emerged thousands of years ago. Long before Columbus, information travelled around the globe.

Of course, using this method, it would sometimes take centuries for simple facts to travel across continents. But the network did function – although where exactly it started from is still in dispute. And it wasn't just knowledge being exchanged; so were goods. Perhaps this explains why the remains of South American plants have been found in ancient Egyptian tombs. Traces of cocaine have also been found in Egyptian mummies – which archaeologists had only previously found in 5,000-year-old corpses in Chile. How were the leaves of the coca plant transported to Africa, if not using boats to cross the sea? And who first built the pyramids? That's by far the biggest mystery faced by archaeologists today.



You'll find no mention of this date in history books.

However, it was the most important sequence of numbers since the end of the Second World War: 2951954, or 29th May 1954. On this day, the secretive Bilderberg Group met for the first time – in a hotel of the same name in Oosterbeek, Holland.

Since then, the Bilderberg Conference has taken place every year – attended by around 140 extremely influential people from the financial and economic circles of the US, Canada and western Europe, as well as guests from the worlds of politics, society and the media.

In 2015, the meeting was held at the Interlpen Hotel in Austria's Tyrol region. Investors and politicians came together to discuss various issues including cybersecurity, the threat posed by chemical weapons, globalisation and the upcoming US elections – all in total secrecy. Many experts believe that this secrecy means some form of collusion must take place. Think about it: the most powerful representatives of industry meet with leading

politicians for three days – with no independent journalists anywhere in the vicinity. Some reporters have even been arrested for trying to gain access to the building. Every conversation is confidential and no minutes are taken. Future policy decisions can be made there without legislative approval.

German sociologist Hans-Jürgen Krysmanski is convinced: "The Bilderberg Conference is the highlight for a permanent group of lobbyists." Krysmanski even sees Bilderberg as part of a large secret network that gives the multinational corporations ever more influence over politics. That's because, in addition to Bilderberg, there are many more so-called private meetings. These include the yearly World Economic Forum (which drives globalisation) held at Davos, the exclusive Swiss ski resort and the Munich Security Conference, a stooge of the arms industry and an international forum on security.

The Bilderberg Conference is, therefore, just one arm of this powerful corporate octopus; a quasi ministry of the top-secret global government.



Which secret did LEONARDO DA VINCI take to his grave?

It's arguably the most unusual decryption programme ever made. Using what's known as emotion-recognition software, Italian computer expert Nicu Sebe from the University of Amsterdam and researchers at the University of Illinois unravelled the world's greatest art mystery: Leonardo da Vinci's Mona Lisa.

One of the peculiarities of the painting is that, depending on the angle it's viewed from, the woman seems to display different emotions: sometimes she's smiling, at others she looks serious. This Mona Lisa code was only deciphered 500 years after the death of its ingenious painter. The code? 83-9-6-2: the Mona Lisa's face is 83% happy, but the position of her eyes and the curve of her lips mean that she also displays 9% disgust, 6% fear and 2% anger.

Much more is hidden behind the enigmatic smile. In painting the iconic picture, Leonardo uncovered an ancient mystery – the miracle of sight. He had secretly obtained corpses, studying the structure of their brains, muscles and eyes. He needed to understand them before he

could paint the Mona Lisa and her way of seeing the world. It proves that the artist was the first to understand how a human perceives the world: the way the eye processes visual information, while the brain interprets it.

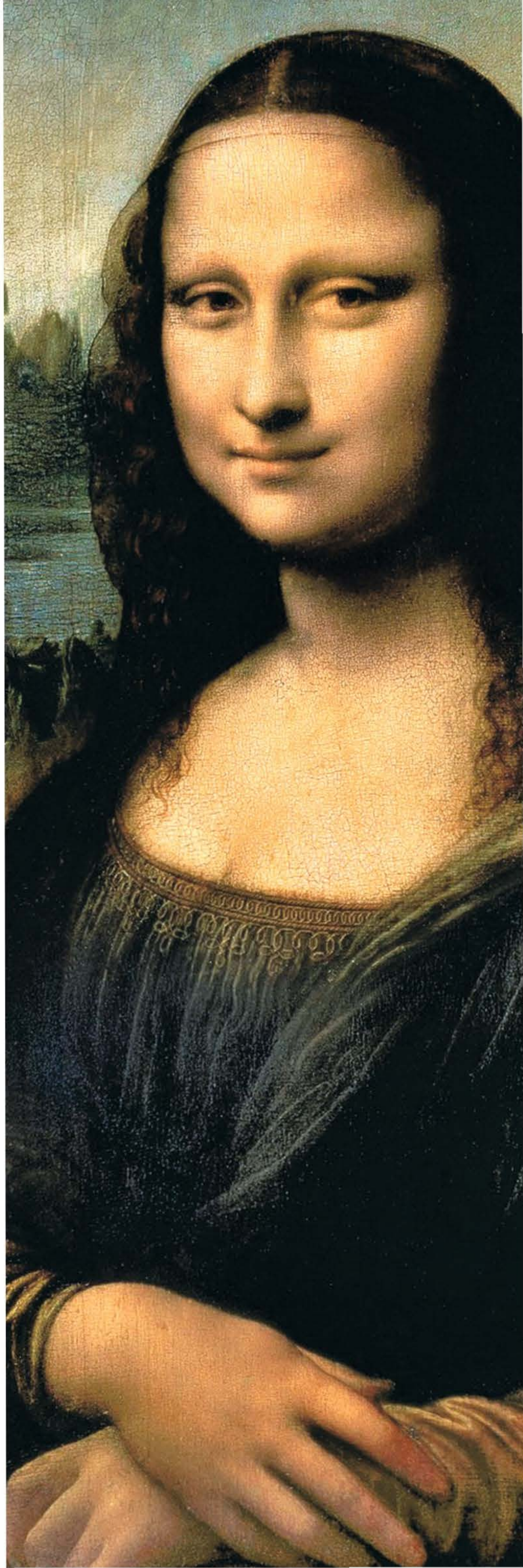
Margaret Livingstone, a vision expert at Harvard Medical School, says: "The elusive quality of the Mona Lisa's smile can be explained by the fact that her smile is almost entirely in low spatial frequencies, and so is seen best by your peripheral vision. So when you look at her eyes or the background, you think she is smiling. But when you look directly at her mouth, her

smile seems to vanish." Leonardo studied his model for months. He didn't just paint a picture – he produced a profile of a person. It's been described as a painted psychoanalysis. But the painting also symbolises something else: a new way of seeing the world. Each viewer creates their own Mona Lisa – depending on their

viewpoint. That's probably the most important Mona Lisa code: everyone has the freedom to see things the way they want. Of course, 500 years ago that would have been very dangerous. Back then, the Church's world view was the only truth.



**DA VINCI'S
LEGACY**
For 500 years,
the Mona Lisa
kept the
mysteries of its
creator – until
the secrets of
her smile were
finally revealed.





What is Google really doing with **OUR DATA**?

How do you persuade someone to let down their guard and give away their most intimate secrets? In a secluded Google research laboratory with the codename GWC7, just south of San Francisco, someone believes they have found the answer: offer the person a long, healthy life.

The GWC7 researchers have developed a method by which malfunctions in the body can be detected and treated long before they become an issue. The only thing that Google demands in return is sensitive information about people's health. And, for this reason, GWC7 plans to get into our heads: not just in spirit, but also quite literally. Google wants to enter our bones, muscles and veins – to breach every single cell. How? By using nanoparticles! These are 2,000 times smaller than a red blood cell and are far more resistant to viruses.

The disease-detecting nanoparticles will enter the bloodstream via a swallowed pill. The tiny look-outs will act as an early warning system, reporting any impending problems to a wrist-worn sensor. Collated data will be forwarded to the data centres of GWC7, where a diagnosis programme is running.

So could a system like this save lives? Of course! Google estimates 100,000 per year. Yet some experts are critical of the project. After all, who can guarantee that the stored data will not be misused?

Medical historian Paul Unschuld warns that agencies could purchase the data in order to deliver 'health ratings'. These assessments could affect your chance of getting insurance or renting a flat, he explains. One thing is certain: if nanobots start to patrol our bodies and only GWC7 is accountable, it'll be the start of a new era for all mankind.

Is Putin developing a SUPER WEAPON?

For the NSA analysts in Fort Meade, Maryland, it came as a total shock. During

a news broadcast on Russia's state-run TV channel in November 2015, a top-secret blueprint appeared onscreen for a few seconds. It showed a giant nuclear torpedo, alongside the codename 'CTATYC-6'

(Status-6) – initials denoting a top-secret armaments project run by the Russian military. "It's true some secret data got into the shot, therefore it was subsequently deleted," said Dmitri Peskov, a spokesman for the Kremlin.

The Russian secret service didn't hang around. All posts about the secret torpedo code were removed from the TV channel's archive, videos were deleted, websites were blocked – but all to no avail. The internet is too quick. The distribution of the broadcast could no longer be stopped.

The secret blueprint shows a long-range nuclear torpedo that could alter the balance of

power between Russia and the US. Its stealthy design means that a US missile shield would be useless against it.

Initial analysis of the secret document showed that the nuclear torpedo can travel at 114mph, 1,000 metres below the water's surface. It has a potential range of 6,200 miles. The US would be powerless to defend itself and the

consequences of an attack would be catastrophic. According to the document, affected areas would be "so contaminated with radiation that they would be agriculturally, militarily and economically unviable for a long time."

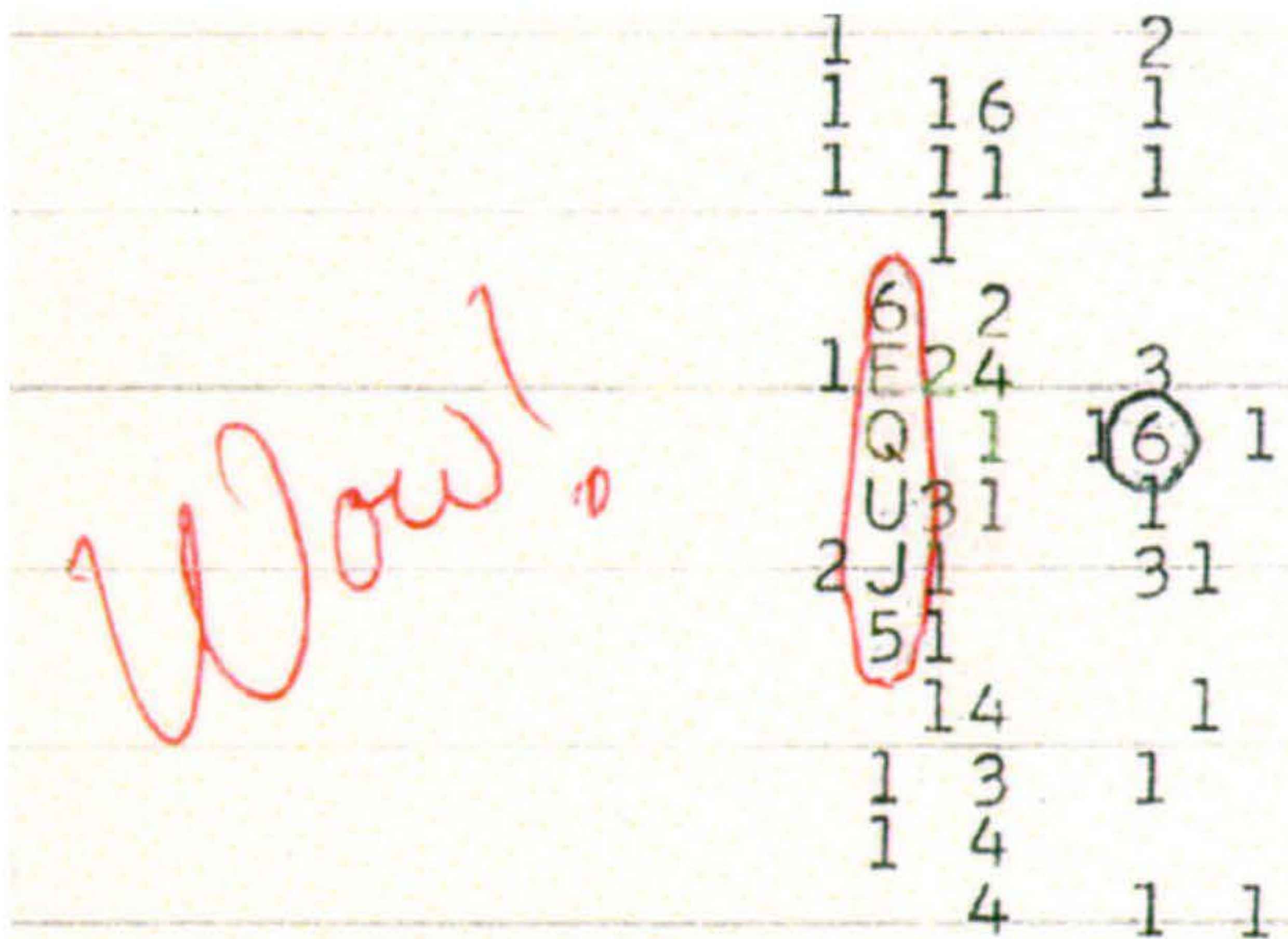
The torpedo would be a

nightmare for the US. Not so for Russia, according to military expert Viktor Murachowski. He says it would put the country in a strong strategic position.

However, it is unclear whether such a torpedo actually exists – or if the leak was planned. Some say the picture was aired because the Russian government want the world to live in fear of a potential attack...



MEGA TSUNAMI
Russia's nuclear super weapon could be even more devastating if it exploded off the coast and triggered a gigantic tsunami.



Is a secret **ALIEN MESSAGE**
hiding in the Wow! signal?

All day, astronomer Jerry Ehman has been using Ohio State University's Big Ear radio telescope to sweep the sky for possible signals from other civilisations. So far, he's heard nothing more than the hum of space, until suddenly, at 22.16, he receives a blast of radio waves and the printer whirrs into life. A series of letters and numbers appears – a strange frequency reading '6EQUJ5'. The signal has come from deep space. Ehman circles it with a pen and writes 'Wow!'

Nearly 40 years have passed since that night – but the so-called Wow! signal remains a mystery. The one certainty: it travelled from somewhere near the constellation Sagittarius – 200 light years away. “The signal never reappeared,” says physicist Harald Lesch. For that reason, Ehman has expressed doubts

that the signal originated from an intelligent extraterrestrial source: “We should have seen it again when we looked for it 50 times. That suggests it was an Earth-sourced signal that simply got reflected off some space debris.”

But other scientists believe that the signal frequency hints at something truly out of this world. It was measured at 1420.4556

MHz – close to what's known as the hydrogen line, the electromagnetic radiation spectral line that is created by a change in the energy state of neutral hydrogen atoms. As hydrogen is the most abundant element in space, extraterrestrial beings might use that frequency to transmit a signal.

There's just one thing:
if the sender really was
an intelligent being, they'll
to wait a while for an answer:
interstellar radio message
22 years to reach Earth.



VOICE FROM THE DEEP
The universe is never silent. But the Wow! signal was 30 times louder than the normal level of noise found in space.

Did the Knights Templar worship an **IDOL**?

“What is Baphomet?” It’s a question the members of the Knights Templar are to hear repeatedly, following their arrest and torture on Friday 13th October 1307 by troops loyal to the French king, Philip IV. The Templars are said to have worshipped the idol – a black statue with three faces and a beard. Later, Baphomet was depicted in a different way with devil horns and eagle wings. However, their torturers believed that Baphomet was more than an idol: they were convinced it was a code – behind which the source of power of the Knights Templar was hidden.

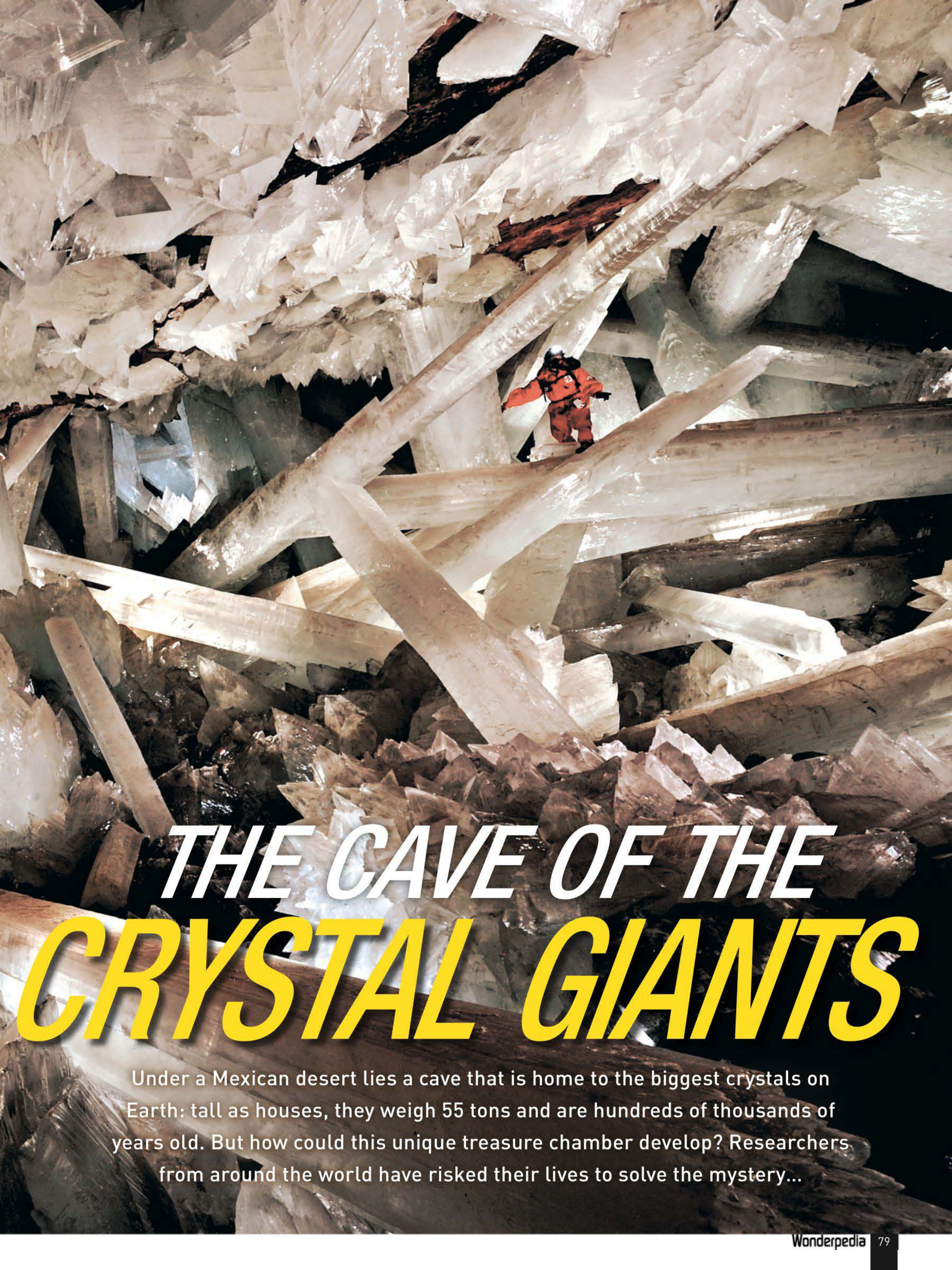
However, although the knights confessed under torture to acts like sodomy and blasphemy, no information about the Baphomet code was revealed. For centuries it appeared unbreakable. Until historians discovered something surprising: Baphomet was a common regional name for the founder of Islam: the prophet Muhammad.

So did the Christian Templars worship the Muslim prophet? It seems improbable, but there may be some truth behind the legend. That's because the Knights Templar and the Muslims were not as hostile to each other as the Church liked to think. Instead, the knights adopted the Arabs' technology and knowledge and made them their own. They even fought alongside the Muslim Assassins. The Templars went on to become one of the most powerful forces in Europe – until they were finally crushed.

SLUMBERING GIANTS

The Naica caves were fed by mineral-rich groundwater for hundreds of thousands of years. This provided ideal conditions for the crystals to grow into towering pillars. It was only in 1985 when mine workers drained the caves that this process of accretion came to an abrupt halt, giving scientists an opportunity to examine them.





THE CAVE OF THE CRYSTAL GIANTS

Under a Mexican desert lies a cave that is home to the biggest crystals on Earth: tall as houses, they weigh 55 tons and are hundreds of thousands of years old. But how could this unique treasure chamber develop? Researchers from around the world have risked their lives to solve the mystery...

WHAT CAUSES A CRYSTAL

A tremendous wall of heat slams into the men as they set foot in the cave. Pausing for breath, the view in front of them opens up to reveal an enchanted magic forest – a labyrinth of huge, intertwined crystal columns. Sixteen years ago Mexican miners stumbled across this unique natural miracle in the mountains of Naica by accident. It presents scientists with a puzzle: how could the glittering giants have formed? The story begins with a dying underground volcano 25 million

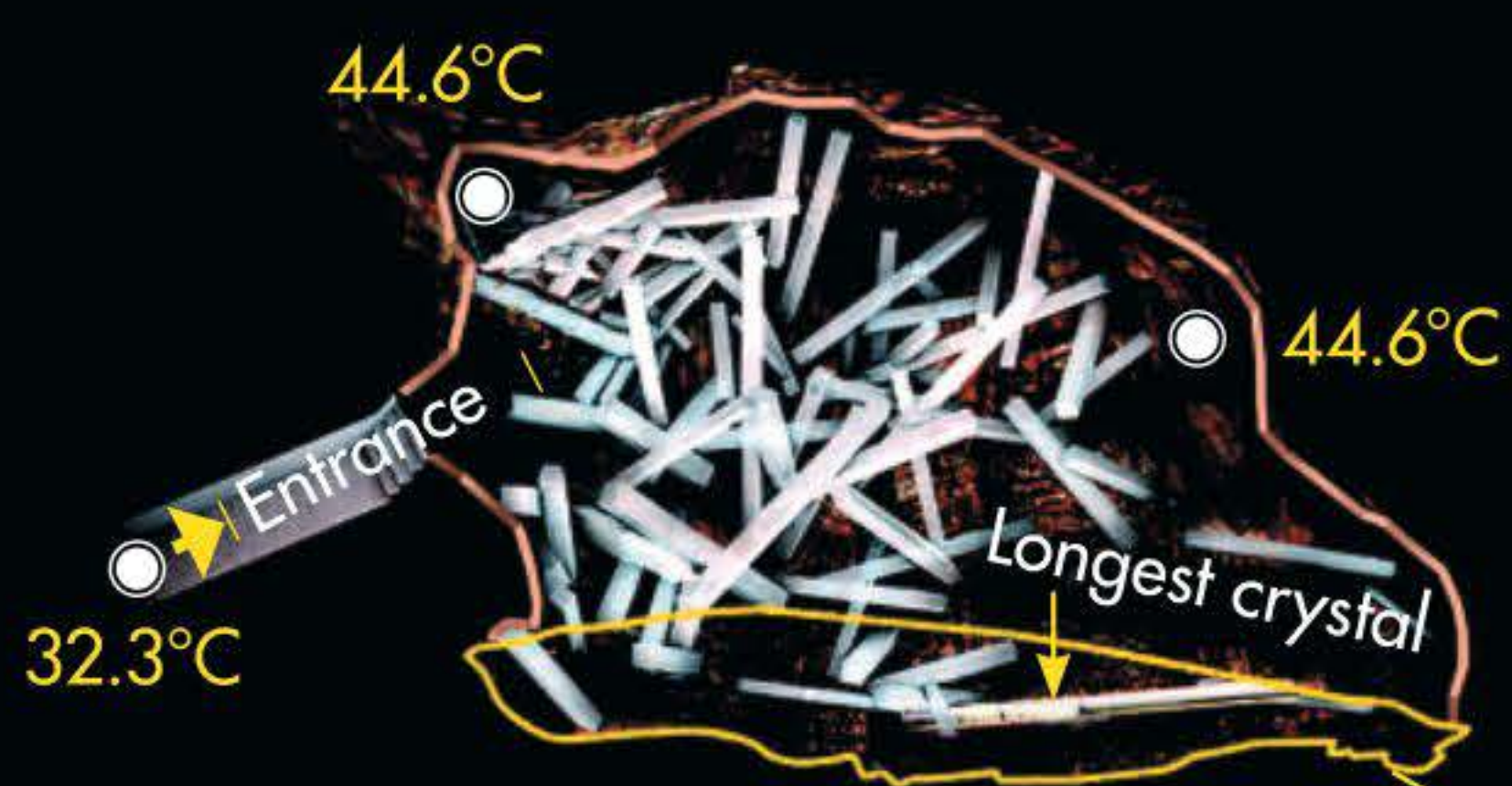
years ago. Iron and minerals from its magma mixed with groundwater to form hydrothermal fluids, later forming selenite crystals. It was only because stable conditions existed in the caves for millennia that the crystals were able to grow as high as trees. Without the deeper-lying magma chambers, which keep the stone and groundwater at a constant temperature and ensure the steady supply of sulphur and calcium, the crystals would long since have collapsed...

THE CAVE FROM ABOVE

— Giant crystal

▲ Door

● Temperature



HEAT CHAMBER

With temperatures of up to 50°C and 90-100% humidity, it's no wonder geologists have described the Naica caves as "the most unwelcoming research laboratory in the world." Researchers need to wear special protective icesuits – and even then they can only spend a maximum of 50 minutes in this vast crystal palace.

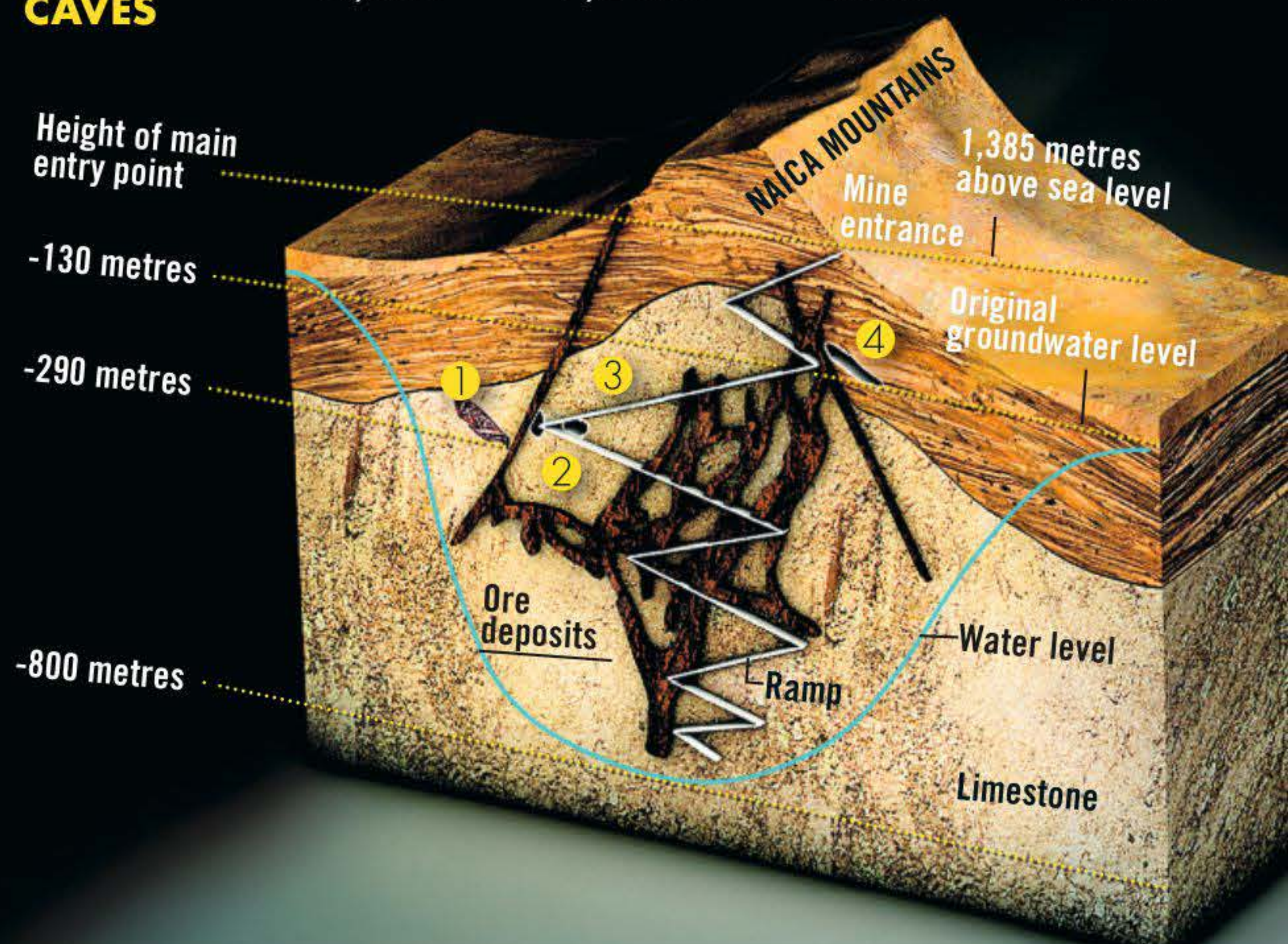


A TREASURE CHAMBER 300 METRES DEEP

Scientists from six different nations have been exploring the Naica caves for the past three years. They've been measuring the crystals and taking samples of rock in order to learn more about prehistoric earthquakes and groundwater movements. Their research has uncovered three more crystal caves (see diagram right). The caves have since been sealed because the influx of air was causing the selenite columns to slowly disintegrate. Once they are reflooded with water, the crystals will begin to grow again.

POSITION OF THE CAVES

- ① Cave of Crystals
- ② Queen's Eye cave
- ③ Cave of Candles
- ④ Cave of Swords



TO GROW?

NUMBER OF CRYSTALS

The exact number of selenite columns has been estimated at 170. So far, 149 have been documented and examined.

LONGEST CRYSTAL

The crystals reach lengths of 14 metres and have diameters of up to four metres.

CROSS-SECTION ENLARGED VIEW

SIZE COMPARISON

THIS IS HOW THE CRYSTALS FORMED:

25 MILLION YEARS AGO

Magma from an underground volcano rises towards the surface and presses mineral-rich thermal water into the rock. This forms the Naica Mountains.

1 TO 2 MILLION YEARS AGO

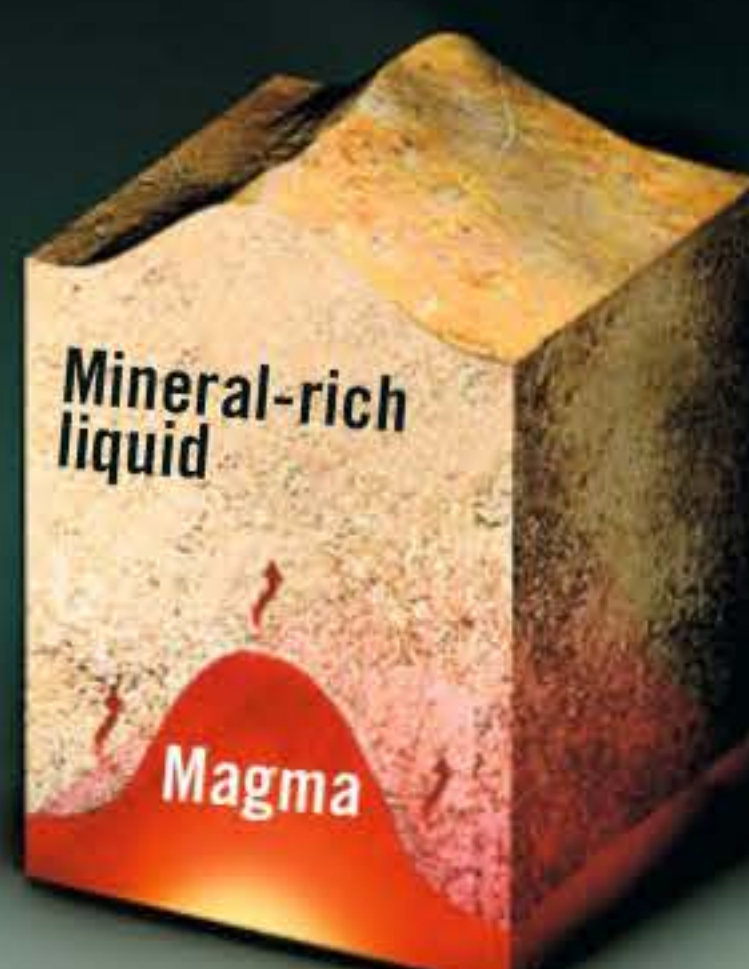
As the temperature falls, caves form as a result of movements in the Earth's crust. Water floods the caves, dissolving calcium sulphate from the limestone in the process.

600,000 YEARS AGO

The temperature levels off at 58 degrees. Selenite crystals form out of the calcium sulphate and grow into massive columns.

AROUND 1985

Miners looking for iron and silver deposits drain the mine. 15 years later they stumble across a cave of crystal giants, whose growth has been halted as a result of the lack of water.



[LAB TEST]



Ricocheting bullets are feared by even the most experienced soldiers. But although they are unpredictable and extremely dangerous, they also act according to the laws of nature...

THE UNBELIEVABLE PHYSICS

RICOCH

The time for negotiation is over: Man Haron Monis has just shot one of the 18 hostages he is holding captive – without warning. An elite unit of Australian police officers storms the Lindt cafe in downtown Sydney, firing more than 20 shots at the Islamist terrorist. Thirteen bullets hit him; the rest slam into the walls. Monis is killed and the mission appears to have been a success. But as

the smoke clears, the true cost of the operation becomes apparent: three hostages have been injured and 34-year-old Katrina Dawson has been fatally hit. The events of 15th December 2014 end in a bloodbath. Did Monis return fire? No. Forensic analysis reveals that Dawson was “struck by six fragments of a

police bullet or bullets, which ricocheted from hard surfaces into her body.” These bullets altered their flight path and flew through the room like

shrapnel. But how

exactly do ricochets form? Can they be avoided? *Wonderpedia* explores the physics behind these volatile projectiles...

Bullets can be deadly even after impact. **Ricochets can claim more lives than regular shots.**



OF

HETS

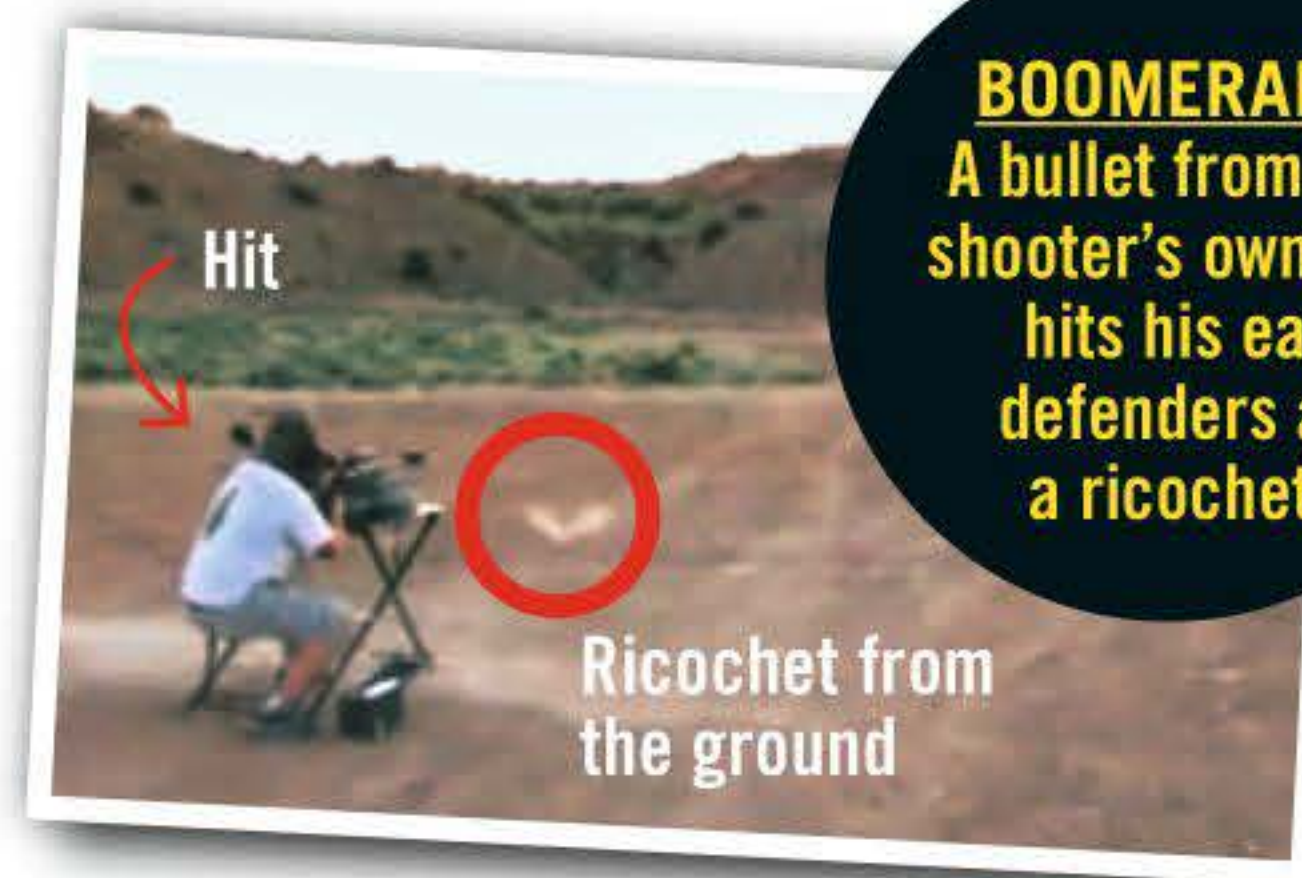
HOW DOES A BULLET BECOME A GRENADE?

'Mushrooming' is the term experts use to describe the process when projectiles are deformed upon impact (shown above). The projectile can shatter into tiny fragments and ricochet in all directions.

1

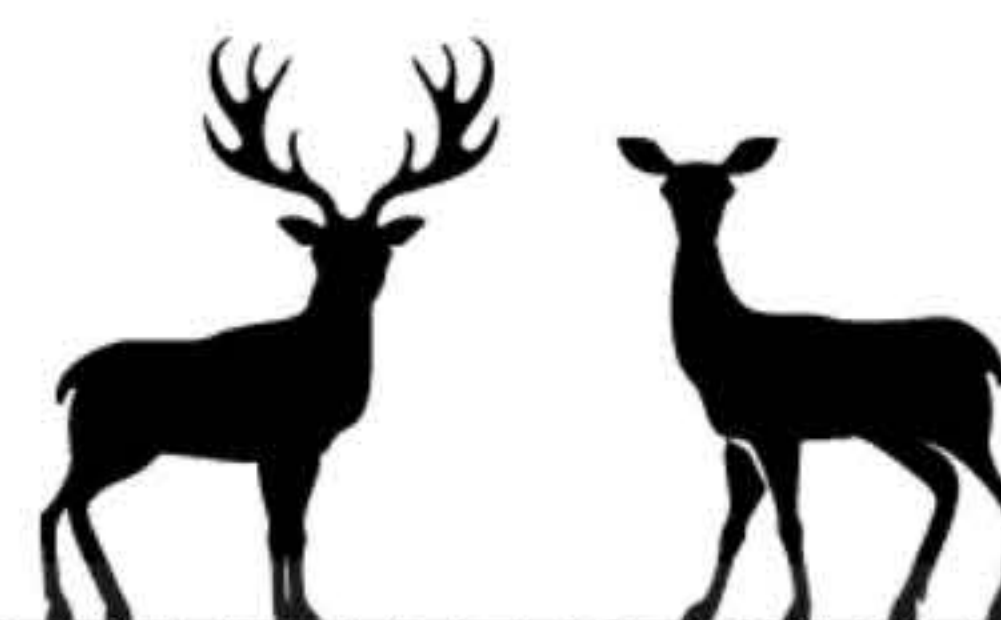
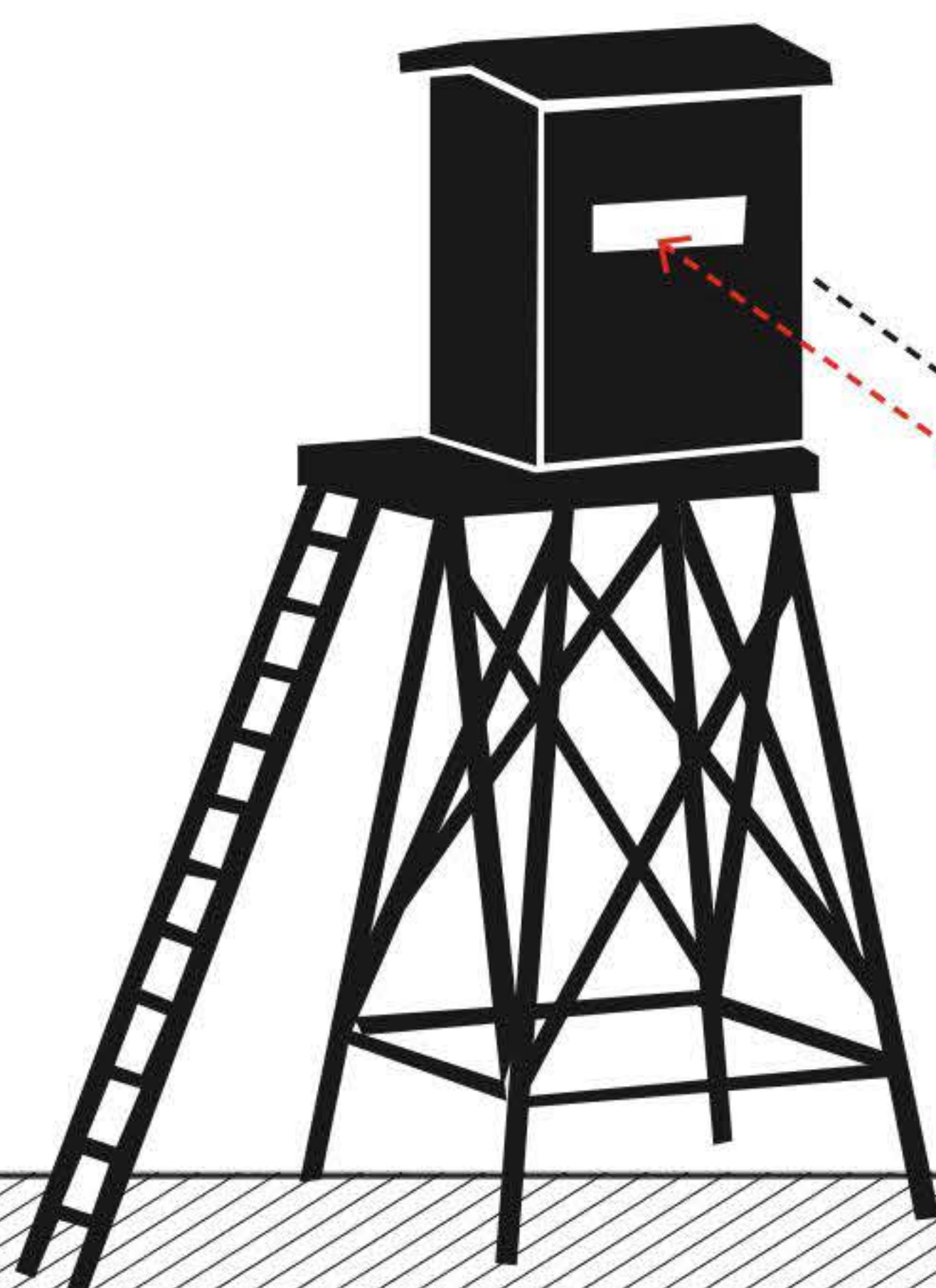
HOW CAN A RICOCHET BOUNCE OUT OF THE GROUND AGAIN?

When shots are fired from a raised stand, the shooter must exercise caution: even a shot fired into apparently loose, soft earth can prove fatal. Stones hidden under the surface can cause the bullet to ricochet in different directions, including straight back from where it came. There have been cases where a bullet has penetrated half a metre into the ground and re-emerged as



BOOMERANG
A bullet from the shooter's own gun hits his ear defenders as a ricochet.

a ricochet. A shot can even ricochet off stones in the subsoil during its route through the earth, meaning a steep shooting angle like the one above can be extremely dangerous for whoever is pulling the trigger...



2 HOW DANGEROUS ARE BULLETS IN THE AIR?

What goes up must at some point come back down: in the case of a 9mm bullet fired into the air and travelling at a speed of 350 metres per second, the turnaround would happen at a height of 1,100 metres. Bullets shot into the air usually fall back to Earth with terminal velocities far lower than their muzzle velocity (the speed of a projectile when it leaves the gun). But when shots are fired at

shallow angles, the risk of dangerous ricochets rises – the bullet maintains its trajectory and is less likely to go into free fall. If a human happened to be standing where it fell, it could easily shatter their skull. In fact, people are often killed by celebratory gunfire – in 2011, falling bullets left three dead on New Year's Eve in the Philippines. For that reason, blank ammunition is always used for official gun salutes.

The fatality rate for **celebratory gunfire** is five times higher than for other types of gunfire, because falling bullets often strike victims in the **head**.

AIR SHOT

Unlike ricochets, bullets do not deform when shot into the air. They retain their aerodynamic shape and fall silently back to Earth.





SECRET MISSION
Sky marshals only make themselves known in an emergency. And even then they don't always brandish a weapon as shown here in the film *Non-Stop*.

3

WHY ARE SKY MARSHALS ALLOWED TO FIRE WEAPONS ONBOARD PLANES?

Opening fire six miles above the ground sounds like a death wish: if a sky marshal – the term for a counter-terror agent disguised as a passenger – shoots wide of the mark or a ricochet smashes through the fuselage, then you're in big trouble.

Despite this, no shooting ban applies to sky marshals, who are deployed to combat any would-be terrorists on board.

US federal air marshals (FAMs) carry a Sig Sauer P250 or P229 pistol as standard.

On board they use ammunition specially developed for the purpose of hitting 'soft targets'. These 'frangible' bullets will disintegrate upon contact with a surface harder than the bullet itself or will fragment into tiny pieces when the target is hit. As a result

they achieve a high level of stopping power, because they transfer a large part of their kinetic energy to their target when they strike instead of gliding straight through. This means the shots can disable a terrorist, but won't

penetrate hard materials like an aircraft's cabin wall.

Sky marshals aren't just deployed on flights originating in the US. Almost every European country has a force of its own.

In the UK, armed undercover police were

trained for deployment on passenger flights after a flight security overhaul in 2003, although the precise details remain top secret. After all, it's important that the marshals work in secrecy in order to prevent terrorists from getting an information advantage.

Ricochets on board could lead to catastrophe. **For that reason sky marshals use a special type of ammunition for soft targets.**

4 HOW FAR CAN A RICOCHET FLY?

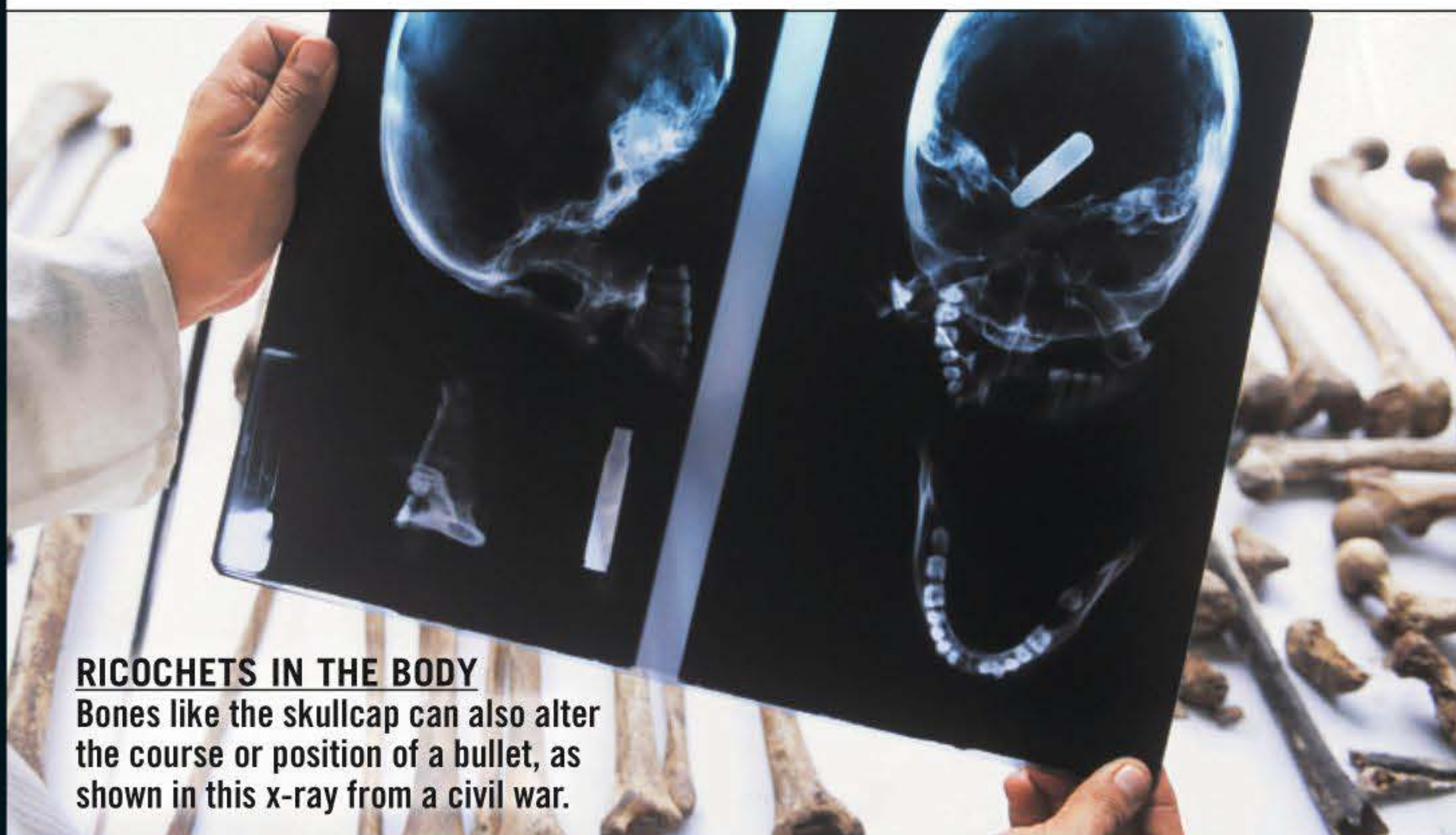
The shallower the shooting angle and the harder the target material, the more power a ricochet contains. In a series of experiments at the University of Bern in Switzerland, some bullets bounced back from a distance of 1,500 metres. Even a penetrating gunshot wound can divert a bullet without taking away the majority of its energy.

5

A curled-up armadillo

CAN RICOCHETS BOUNCE OFF A BODY?

Grazing gunshots act in the same way as ricochets – the body alters the path of the projectile and the shot lurches off course. But for a projectile to rebound in the same direction in which it was fired is rare – at least when it is a human body that has been hit. Where some animals are concerned, that's not always the case: the thick hide of wild boars has been known to deflect bullets, while in 2015 a Texan man was wounded after firing at an armadillo. The bullet bounced off its protective shell and hit him.



RICOCHETS IN THE BODY

Bones like the skullcap can also alter the course or position of a bullet, as shown in this x-ray from a civil war.

6 AT WHAT POINT DOES A RICOCHET BECOME DANGEROUS?

They're almost always dangerous. Nine times out of ten, bullets that hit unprotected skin cause injury – something confirmed by ballistics experts from the University of Bern. The researchers discovered that a weight of just ten grams (about the

same as a boiled sweet) was enough to cause damage when it was dropped from a height of one metre and hit a steel pin with a diameter of six millimetres positioned on the skin. Even this mini-strike caused the skin to break in the experiment.

7 CAN YOU CONTROL RICOCHETS?

There are several reports of snipers apparently able to shoot around corners – by deploying ricochets in a controlled way to hit targets supposedly hiding behind cover. But to do so the shooter would need a whole lot of luck. In reality, rebound shots can't be controlled and the sniper would have to give away his hiding position to get the correct shot at the right angle.

In the past, ricochet fire has sometimes been deployed in order to extend the range of the bullets or increase their impacts. Artillery was aimed in such a way to allow the shot to strike and rebound in a succession of skips, like a stone being skimmed. Using this method, bullets fragmented and the scattering effect had the potential to increase the number of hits.

RISKY EXPERIMENT

Using remote control, physicist Andres Wahl fires a loaded gun at himself from a distance of three metres. The water decelerates the shot and therefore poses no danger.

8 HOW SAFE ARE YOU FROM RICOCHET FIRE UNDER WATER?

In principle, bullets fired from a gun or rifle behave in exactly the same way underwater

as they do above the surface. The oxygen contained in the cartridge is enough to release the shot, but during its trajectory the bullet quickly loses speed and rotation. This means that it drifts off course and sinks to the bottom after just two metres. As water is 800 times more dense than air the bullet is

Water is 800 times denser than air. This means it forms an effective protection against ricochets.

subject to extremely strong resistance. The same principle applies to ricochets, except the water decelerates the deformed projectile even more severely. On ships, barrels of water are used to protect against pirates who might fire bullets at the boat. These liquid shields rob shots of their energy.





9

CAN A RIFLE BULLET BOUNCE OFF A LAKE?

In films, swimmers are often portrayed being shot underwater. Yet the chances of producing dangerous ricochets, rather than hitting the target, are higher when shooting at water. That's because when projectiles travelling at high speeds and at a shallow angle hit the water's surface, the usually permeable

liquid acts like an impenetrable barrier. The bullet rebounds at approximately the same angle at which it hits the water. In Salzburg, Austria this law of physics has even become a sport. The annual 'Preber Shoot' sees competitors firing not at a target, but at its reflection on the surface of the glassy lake.

10

WHO WAS STRUCK BY THE MOST FAMOUS RICOCHET IN HISTORY?

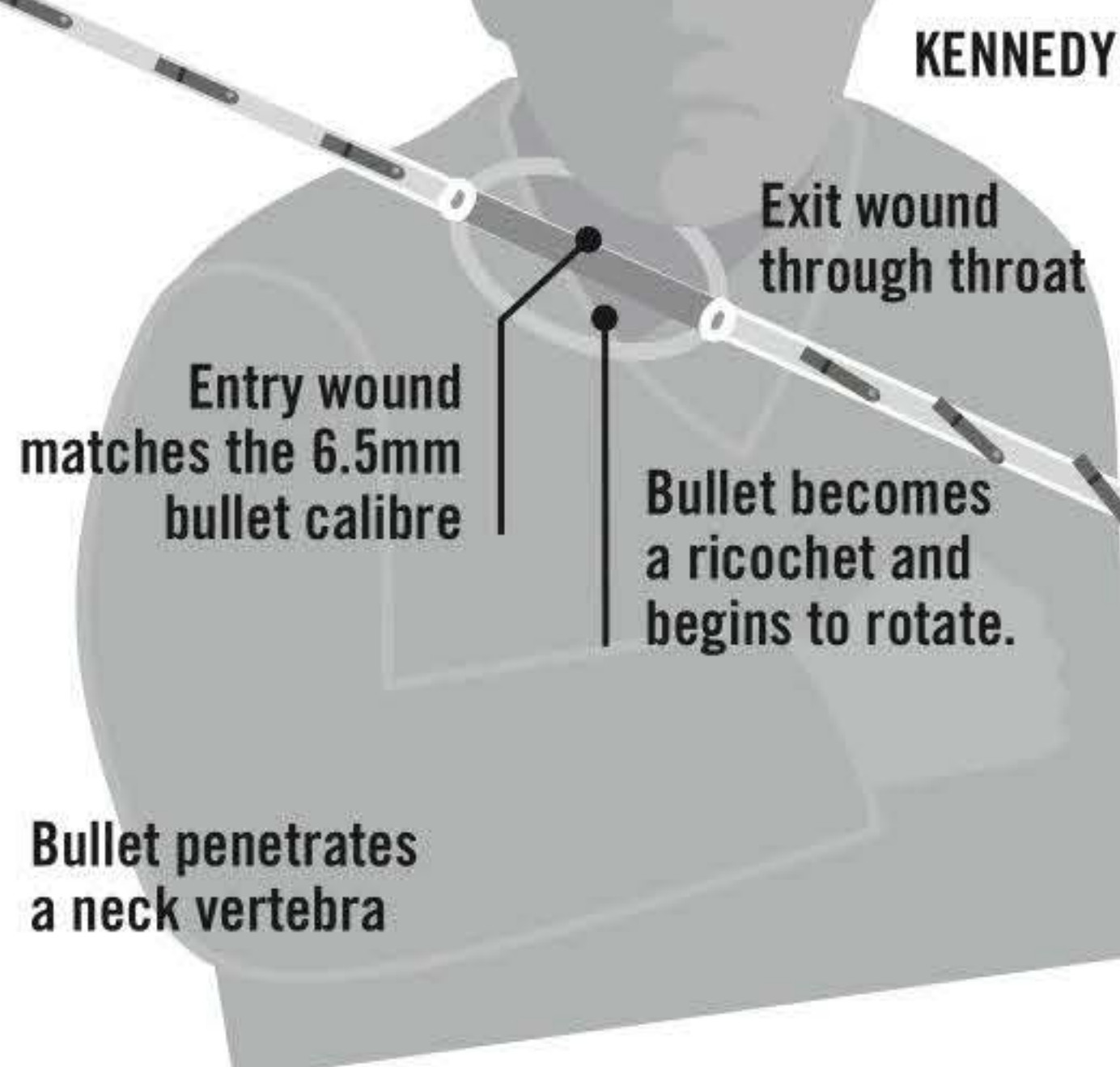
On 22nd November 1963 Lee Harvey Oswald shoots John F. Kennedy. Conspiracy theorists see Oswald's second shot as a 'magic bullet' because Oswald hit not just the then-US president, but also Texas governor John Connally, who was travelling with him. How could one bullet hit two people? What's more, JFK's horrific

gunshot wounds didn't match the calibre of the rifle used. But the latest analysis has shown that Oswald's 'magic' shot was nothing more than a ricochet, acting in accordance with the laws of physics. The bullet went through Kennedy's neck, turned and struck Connally's upper body. Then it grazed his underarm and finally lodged in the governor's thigh.

ROUTE OF THE BULLET

Three shots were fired by Oswald: the first was wide of the mark, the second (illustrated below) injured Kennedy and then Connally. The third struck Kennedy's head – killing him.

Speed of the bullet
518-549 metres per second



NERVE REFLEX

An injury to the spinal cord causes a neurological reflex: Kennedy pulls his elbows upwards, also known as the Thorburn position.



BIRD'S EYE VIEW

Kennedy and Connally are sitting in the car when a bullet fired from the fifth floor of a nearby building hits both of their bodies.



Entry wound matches the 3cm length of the bullet
457-488 metres per second

Fifth right rib is shattered

Projectile grazes Connally's arm backwards in flight

Exit wound in the chest cavity measures approx 5cm

274 metres per second

Bullet is lodged in the thigh

122 metres per second

[AND FINALLY]



PHOTOS: Henrik Nilsson; Mohd Khorshid/500px; Austin Thomas/Caters

THE BODY LANGUAGE OF OWLS

Owls stare, wink and pose outlandishly – but what can we infer from these actions? Owl expert Tanja Brandt has interpreted a few particularly eye-catching examples for us

The owl swoops majestically over its territory, nothing escaping its beady gaze: owls, like the great grey owl (left), feel most at home soaring silently through the dusky skies. It might sound like we're stating the obvious, but actually the opposite is true: owls – like all birds – intrinsically dislike flying and, if at all possible, avoid all forms of airborne exertion. They don't want to put on an air show, they just want something to eat. "Even if they feel hungry, owls would still prefer to raid their supply store than go hunting," explains owl aficionado Tanja Brandt. You see, this flying malarkey is energy sapping – if anything it will make them even more hungry. But this isn't the only misconception drawn from the odd behaviour of the grey owl and friends.

Take the chap top right. An owl's wink is the equivalent of our human blink reflex and has nothing to do with the sly transmission of a specific message. "Owls just couldn't do that," stresses Brandt. Our little owl, as the genus is called, is much more likely to be extremely relaxed, and is opening its beak nice and wide. Not to squawk at anybody, but to throw up some pellets – leftovers from its last meal that it is unable to digest. As this procedure is extremely tiring, the bird shuts one of its eyes. And would now like to be alone, please.

And no, the owl in the middle picture hasn't gone into hiding. Tanja Brandt explains: "This one is making full use of its 270-degree rotatable head to clean its tail feathers. Owls only clean themselves when they are fully relaxed." This greasing of the plumage is vital to the birds' survival – without the constant, meticulous removal of dirt, owls would find their ability to hunt seriously impeded. And then the whole slog would have been for nothing because we now know that owls aren't keen on flying.

As for the odd pose struck by the owl on the bottom right... well, he may look a bit tipsy but he's actually showing off – this male owl has been in full view of a female for the entire day. After all, it *is* the mating season, a time when owls contort their bodies into ever more bizarre shapes. "He looks like he's about to take off," says Brandt. But it's also possible that he has just touched down, having leapt from his hide with folded wings and only spread them moments before he reached the ground. An impressive feat!



Letters

*Letters may be edited for publication

Welcome to *Wonderpedia's* Letters page, where you can share your thoughts on anything you see in the magazine. Write to us at *Wonderpedia*, Academic House, 24-28 Oval Road, London NW1 7DT or email editorial@wonderpediamagazine.co.uk

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About time

JOHN O. BEARD, BY EMAIL

I firmly believe that many eminent people have got it wrong when talking about time ('When Will Time End?', April). Everybody seems to talk about time as though it was a thing, but you can't touch it; you can't see, smell, taste or hear it. It is no more a thing of itself than feet and inches or pounds and ounces. A part of the misconception of time could be that we have become indoctrinated by the clock. Our lives revolve around the clock: going to sleep, waking up, going to school or work, eating – everything. The fact that time seems to go faster on a busy day and is longer on a quiet day enforces the feeling that it is an entity. I have yet to find any other explanation that convinces me I'm wrong.

Rough ride

CHRISTINA WISHART, BY EMAIL

I was on a stomach-churning flight recently and wondered whether turbulence can ever bring down a plane. And why do airlines turn on the 'Fasten Seatbelts' sign even when turbulence is mild?

> *Although a bumpy interlude during a flight can be extremely uncomfortable, the likelihood of turbulence bringing down a plane is close to zero. The reason airlines enable the 'Fasten Seatbelts' sign when passing through turbulent air currents is because even light disturbance can turn to severe within seconds – and it's hard to predict in advance. Those not securely belted into their seats can, and have, flown into drinks trolleys, arm rests or the ceiling, breaking bones and sustaining concussions in the process. Hundreds of people have been injured, some seriously, by failing to heed the captain's advice. It's reassuring to remember, though, that there has never been an instance of a plane being brought down by air turbulence alone. It's how pilots react that determines the outcome. Thankfully, airlines train their staff for every possible eventuality and modern planes are designed to cope with all sorts of inclement weather. To read more about how aircraft are serviced to make sure they can deal with turbulence, turn to page 54.*



For more questions, answers and fascinating facts, visit our Facebook page: www.facebook.com/wonderpediamagazine

Food for thought

BRIAN ELVIN, VIA TWITTER

You posted on your Twitter account (@wonderpediamag) that more than half of the food Americans eat is ultra-processed. I wonder how that compares to other countries?

> *The study, published in the BMJ, defined 'ultra-processed' as foods containing several ingredients including added flavours, colours, sweeteners or other additives. That encompasses breakfast cereals, instant soup, soft drinks, frozen ready meals and much more. Said to make up 57.9% of food eaten by Americans over the age of one, such a diet can be incredibly damaging to health. But what about in Britain? Though exact figures are not available, over three billion ready meals were eaten by Brits in 2012. In fact, convenience food makes up the biggest portion of the UK's £70 billion a year food budget. The problem is that processed fast food is often cheaper to produce, and therefore to buy, than healthier alternatives. In contrast, Mediterranean countries are known for their life-lengthening, healthy diets rich in fresh fruit and vegetables, oily fish, nuts and seeds. This relatively unprocessed diet is thought to lower the risk of cancer and heart disease.*

Twist of fate

HARRY SCHONEFELD, BY EMAIL

As always your recent issues have been extremely interesting, particularly the article 'What If Hitler Had Been Assassinated?' (March). These sorts of counterfactual calculations must become trickier the further into the past you go. After all, Hitler also fought as a soldier during the First World War. What if he had been killed in action? Would the Weimar Republic still have existed?

> *It was only when Hitler joined the Nazi Party in late 1919 that the group began its ascent to become a party of the masses, propelled by his oratory and dogmatic vision. Had Hitler not survived WWI, historians believe the party would have fragmented into small splinter groups sooner rather than later. It was predominantly the cult of the Führer that accelerated the Nazi party's rise to power – and the fall of the Weimar Republic.*

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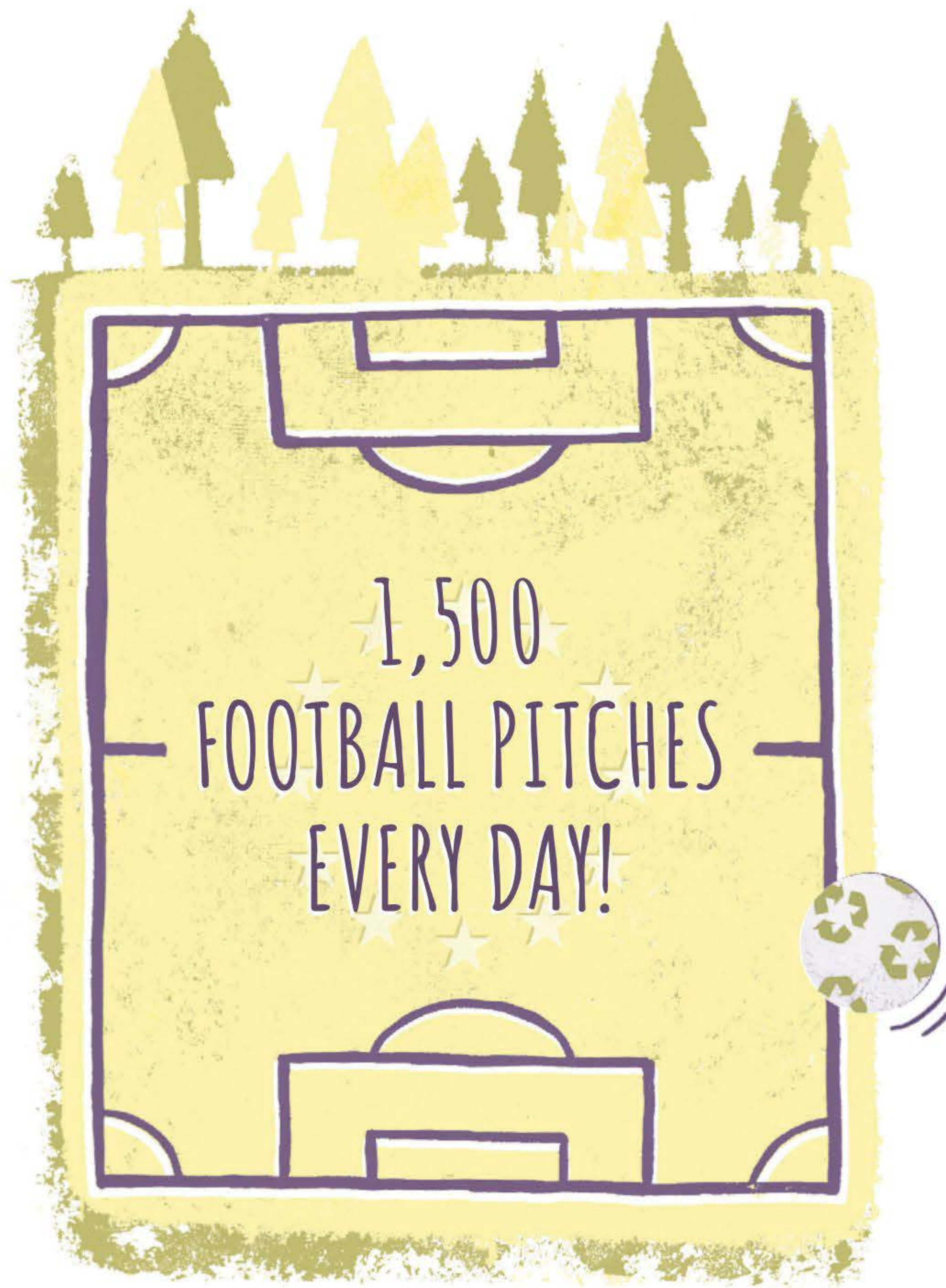


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